
	
Home Tools Library Training Community Download Developers Support	
 Compendium Institute News About Compendium Associated Institutions Acknowledgements	Compendium Institute The Compendium Institute is an open forum for the ongoing development and dissemination of the Compendium methodology. We are currently investigating a variety of models to support our activities. These currently include the maintenance of this website, informal and semiformal gatherings of the community, custodianship of Compendium resources, training and certification, and the authorship of research papers. Compendium Institute Workshop 2005, 10-11 November: Washington DC. [2005.09.22] Compendium 1.4 is released! ... integrated Apache Derby database for single click installation, power mapping from the keyboard, rapid database switching, faster transclusion navigation and more...

Compendium Institute Workshop

Touchstone Consulting, Washington DC

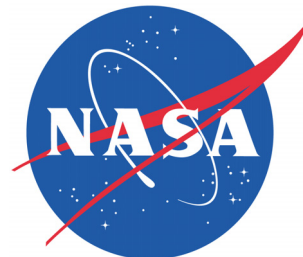
10-11 November 2005

www.CompendiumInstitute.org/community/2005

Workshop Organizing Committee: Al Selvin, Kathleen Rice, Maarten Sierhuis, Jeff Conklin, Simon Buckingham Shum, Dilpreet Chowdhry, Eugene Eric Kim, Nick Papadopolous, Chuck Palus

Proceedings Editor: Simon Buckingham Shum

Workshop Sponsors:



The Open University



Compendium Institute Workshop 10-11 Nov, 2005, Washington DC

Touchstone Consulting
1920 N Street, NW
Suite 600 (6th Floor)
Washington, D.C.
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Directions

Draft Program

Thursday, November 10

8:30pm-12pm Introductory Compendium Tutorial Workshop

Who should attend: People interested in learning more about Compendium software and methods in a classroom setting. Participants should bring their own laptop computer with Compendium 1.4 software already installed.

12pm Lunch

1pm Welcome from Steve Lynott, Chief Operations Officer, Touchstone Consulting

1.10pm-5.30pm: General session - presentations, discussion, and networking

Who should attend: People interested in hearing about and discussing Compendium research, development, and best practices.

Note: presentations should be 30mins max, allowing 10mins for discussion, and 5 mins changeover to next speaker.

1.10pm Presentation: A Brief History of Compendium

Al Selvin

Verizon/Open University UK

1.45pm Presentation: Compendium for Web enabled Collaboration

Peg Duffy, Jane Hertzog, Suresh Kadirvel, Ellen Rotenberg, Richard Fritzon
GlaxoSmithKline

2.30pm Presentation: Filling in the Gaps: Enriching Compendium Maps with Integrated Audio and Video

Simon Buckingham Shum and Michelle Bachler

Knowledge Media Institute, Open University UK

3.15pm Break

3.45pm Using Compendium to Facilitate the Strategy Conversation

Julisa Espinoza, Dil Chowdhry, and Tara Carcillo

Touchstone Consulting

4.30pm Presentation: Communication Design: Understanding the Unintended and Unanticipated Shaping of Decisions, Disputes, and Learning Through Communication

Mark Aakhus
Rutgers University, USA

7pm Dinner

Friday, November 11

8.30am Short Presentation: Compendium as a Sensemaking Tool in Personnel Recovery Missions

Simon Buckingham Shum, Clara Mancini and Al Selvin
Knowledge Media Institute, Open University UK

8.50am Short Presentation: Modelling the Iraq Debate: Mapping Argumentation in a Document Corpus

Alexandra Okada and Simon Buckingham Shum
Knowledge Media Institute, Open University, UK

9.10am Presentation: Supporting Distributed Collaboration for Science Exploration

Maarten Sierhuis and Brent Reeves
RIACS/NASA Ames Research Center

9.55am Field Notes from a Dialogue Mapper

Jeff Conklin
Cognexus Institute

10.40am Break

11.10am Open Presentation Slot: Show+tell what you do with Compendium

This is an open slot for you to briefly describe your use of Compendium – don't be shy! Please inform Al Selvin or Simon Buckingham Shum by the end of Thursday at the latest (sooner is better) if you would like to take advantage of this informal space. A great opportunity to let people know what you're doing, and get feedback. Plan on a 5 min lightning presentation + 5 mins Q&A.

12.15pm Presentation: Expert Practice in Virtual Team Facilitation

Al Selvin
Verizon/Open University UK

12.45pm Lunch

2pm-3.30pm Discussion: Compendium software: features, issues, Q&A

Who should attend: People interested in hearing about and discussing the ongoing evolution of Compendium software tools, including the technical dimensions

3.30pm Break

4-6pm Discussion: Compendium Institute business meeting

Who should attend: People interested in fostering the organizational development and growth of the Compendium Institute and Open Source user community.

7pm Dinner

A Brief History of Compendium

Al Selvin

Verizon/Open University UK

Compendium got its start in the research labs of NYNEX Science & Technology in the early 1990s, standing on the shoulders of a number of giants. This presentation will review Compendium's evolution from an underground effort to combine knowledge modeling with group process facilitation, through the 'middle years' of increasingly large-scale efforts within Bell Atlantic and elsewhere, to the genesis of the current Compendium software, the move to the Knowledge Media Institute, the development of the Compendium Institute, and beyond.

Compendium for Web Enabled Collaboration

Peg Duffy¹, Jane Hertzog², Suresh Kadirvel³, Ellen Rotenberg⁴, Alexander Jarocho-Ernst⁵, Richard Fritzon⁶

¹ GlaxoSmithKline

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⁴ GlaxoSmithKline Consultant

⁵ Rochester Institute of Technology

⁶ GlaxoSmithKline

Abstract

This paper discusses an extension of the Compendium application, which enables it use as a collaboration tool by a team of internal GSK scientists. The original open source code was modified to provide an “export to web” feature, designed for use by a discussion facilitator. For the rest of the discussion participants, a Compendium server version of the code was implemented. This version allows users to participate in discussions using only a web browser on their PCs.

1. User Requirements

Our internal customer is a team leader responsible for leading reviews of biological targets* and deciding whether: to invest more resources in research; to continue to gather evidence before a decision is made; or to discontinue work with the target, either forever or until new evidence would warrant another review. There are many complex factors involved in the process of trying to predict the likelihood of a given target leading to a drug discovery. Some factors are logistical, some scientific and some business related. This Target Selection process is a “wicked problem”¹ well suited to the IBIS² methodology that the Compendium tool supports.

We showed a number of people in a group of prospective customers Compendium. They were enthusiastic to the point of asking, “When can we have this on our desktops?” The ability to record the complex decision making process about a target, so that it could be consulted again in the future, was the Compendium feature that was the most appealing. They were excited at the prospect of no longer needing to remember who was involved in past discussions. Their current process involved asking past participants to search their email, meeting minutes, or written notes to see if they could recall the decision process. The prospective customers also wanted the ability to search for keywords, plain text, references, to attach reference documents of varying types, and to keep author and time stamp attributes for all points in the discussion. Additionally, we showed how they could standardize the issues addressed in their discussions by using a template of starting questions.

We decided to carry out a small, low cost pilot, to develop the minimum set of new functionality required by our customer. The pilot would allow us to determine if the modified software would actually be used and whether it would improve their process. A major user requirement of the pilot was to facilitate scientist participation in these discussions. The current process requires the team leader to talk to individual scientists and solicit their knowledge and opinions. Each target

* A *biological target*, often mentioned as just *target*, is a protein which is hypothesized to be relevant to a biological process associated with a disease.

might require a different group of expert scientists. These scientists are working on other projects and doing this target review is an additional task. For these scientists, it was important not to require them to invest much time in training to use Compendium or IBIS. It was also important that the scientist not be required to install additional software on their PCs. Ease and accessibility from the scientists' regular work environment was critical. Additionally, the customer wanted a way to keep the scientists continually engaged in the conversation and to prevent the discussion from migrating back into email exchanges. All development that was done to Compendium was done to achieve these major requirements.

2. Architecture

To facilitate the contributions of scientists into a discussion, we decided to create a Web-Based or server version of Compendium. In addition to the "export to html" in-built function, an "export to web" feature was required. With this modified standalone version of Compendium, a facilitator would start the discussion by posting a set of questions about a potential target that required informed discussion.

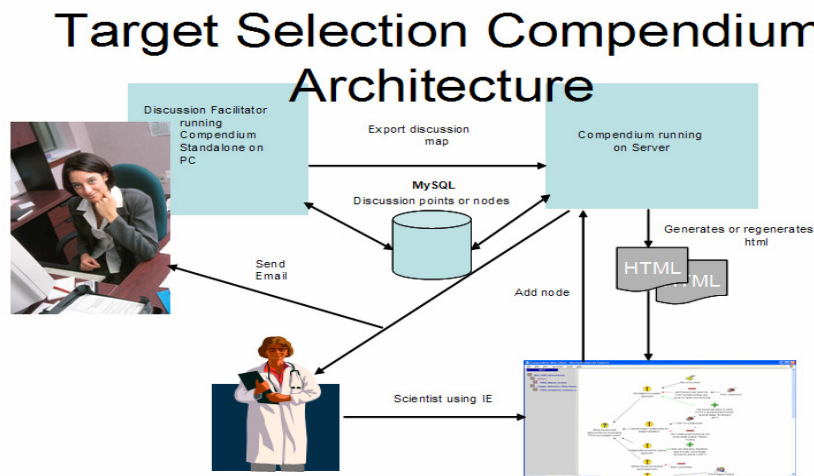


Figure 1 Functional Architecture

Figure 1 shows the architecture of our functional extension to Compendium. A server, which is running Web Compendium and connected to Compendium's MySQL database, receives requests {export to web or add reply} and then generates the html on the web site. Addition of nodes through the web site generates email to all discussion participants. Both Web Compendium on the server, and the facilitator version of Compendium on the PC connect to the same MySQL database. Scientists run Internet Explorer on their PC's to participate in the discussion. Participants (the scientists) do not need to install Compendium to contribute to the discussion. The web site allows users to view the discussion map and click on the nodes to which they want to reply. After each reply or add node from the web, the MySQL database is updated and the modified map is regenerated and refreshed on the participant's browser.

Another feature of Web Compendium is an email alert capability. Whenever a new node is added to a map, all previous contributors to the map receive an email message. A node addition causes the participant's email address to be added to a list of users who are alerted if there are any subsequent responses to the web map. The email list is used to send update notification to all discussion participants. The message content includes what node was replied to, who posted the reply, the label and type of the new reply node, and a link to the map and node that was created. This link allows the recipient to easily navigate back to the map, so that any further discussion is made via the web version of Compendium, and not by private email discussion.

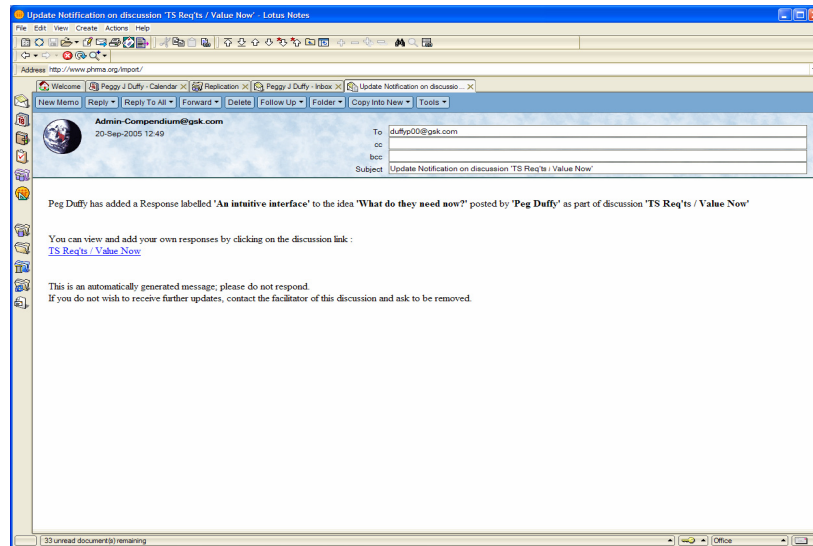


Figure 2 Email notification of Web response

3. Compendium for Facilitator Changes

The original Compendium code was changed as little as possible so that none of the original functionality was lost. All java classes that required changing were sub classed, with only minor type changes made to the original classes. The requirement to login was removed. The XP user id was used to login to Compendium. All our PCs require network authentication already, so we just eliminated the need to login again. The idea of a "top level map" was created for the new "Export to Web" menu item. This map required a special tag called "DISCUSSION_MAPS_PARENT". Only one map within a database can have this tag. This DISCUSSION_MAPS_PARENT map, and all its sub maps, are exported to the Web, when the "Export to Web" is selected by the facilitator.

A limitation of the facilitator version of Compendium is that the facilitator can not upload local file references to the server so that they can be accessible by web users. We delayed the development of this functionality until the pilot proves successful and further development is warranted. The Web Compendium server version of the software does handle uploading of a local file for a reference node.

To keep the facilitator and web server version of Compendium simple and flexible, we also used property files for default user and password, database name and host name, as well as a variety of other variables required by the application for MySQL access. All the changes to the standalone version of Compendium were made to promote ease of use, flexibility, and to enable the web version of a discussion in order to facilitate participation.

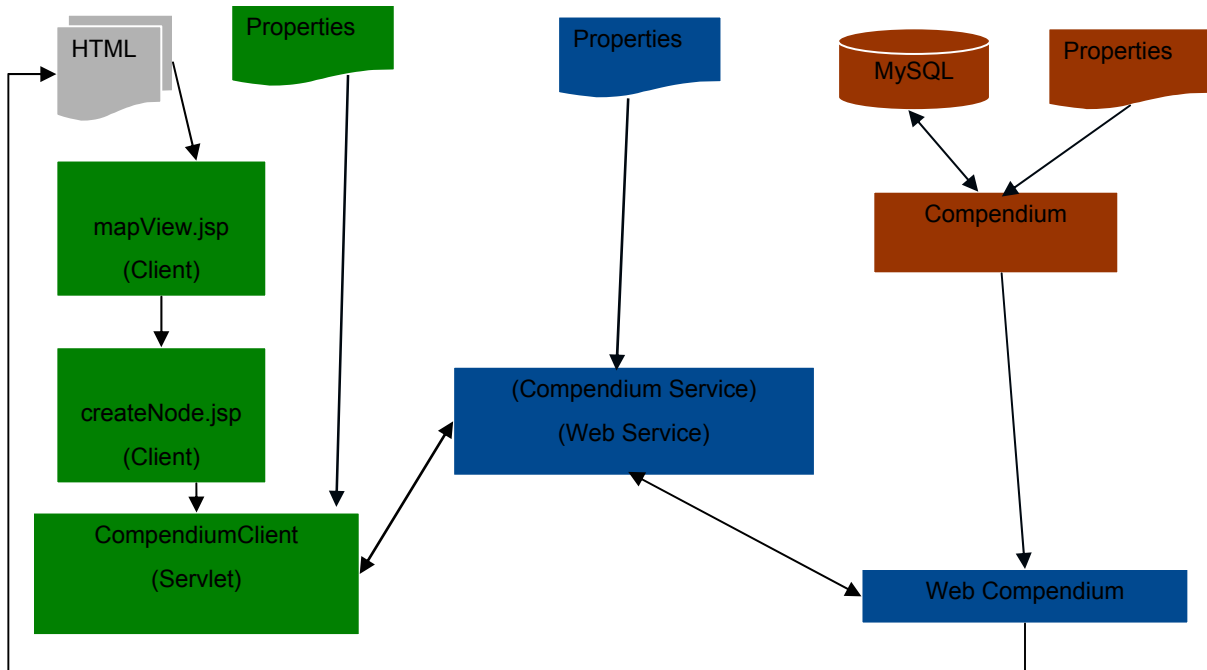


Figure 3. Web Application Architecture

4. Web Compendium Server Development

Both the facilitator version of Compendium and the web site used by scientists must send requests to the Web Compendium Web Service. The CompendiumClient creates the client SOAP message and handles file uploads from the Web. CompendiumClient servlet is the Web Service client for Web Compendium. A new class, which extends Compendium's UIDialog class, is the web service client for the Facilitator version of Compendium. The web service provides two Compendium SOAP services; addNode and exportNodes. The web service then makes Java calls to Web Compendium running on the server. The web service knows how to call our Compendium methods. Compendium running on the server and it uses the same database the facilitator exported from. To prevent collisions, the Compendium Web Service is synchronized so that two different requests can not access the database at the same time. A web service was built into the application so that other future applications might access the information in discussions. (See Section 6 Future Plans)

4.1. Add Node

The user interface of Web Compendium is made up of HTML files, JavaScript, and cascading style sheets. The web user views a discussion web page using mapView.jsp. When the web user right clicks on a node and then clicks on a reply type in the popup menu, createNode.jsp displays appropriate reply form. The user is authenticated when they hit the "Create Node" button, which submits the reply form. If the user's login id is not already in the MySQL database, it is added. When the createNode.jsp form, containing label, details, URL or local filename to be uploaded, is submitted to the CompendiumClient servlet, the information is then passed to the Web Service. The CompendiumClient Servlet constructs a SOAP message for the Web Compendium Service. The message is a request with required parameters; like user id, the node id of the node they are replying to, database name, parent map id, and the type of node they are adding, the label and details for the new node, or the local file name they are uploading. If a local file is added as a

reference node, it is uploaded from Web Compendium and CompendiumClient servlet handles this.

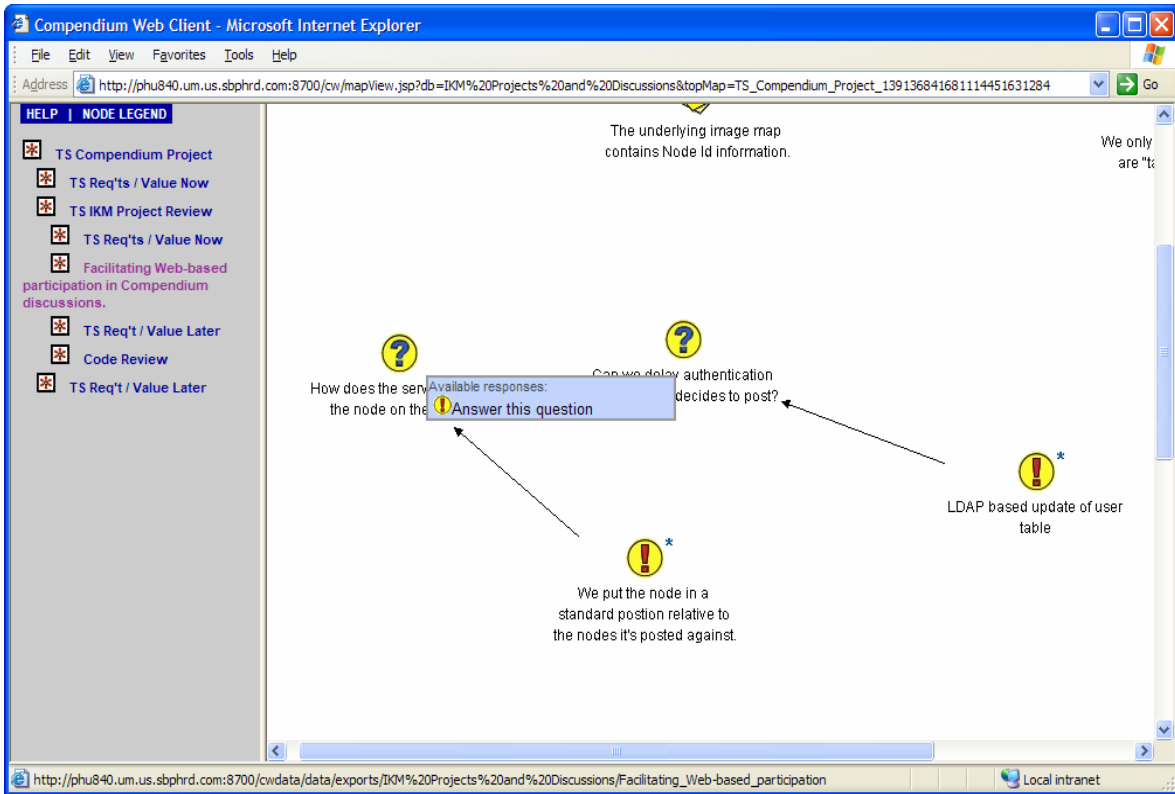


Figure 4 Posting a reply from the web

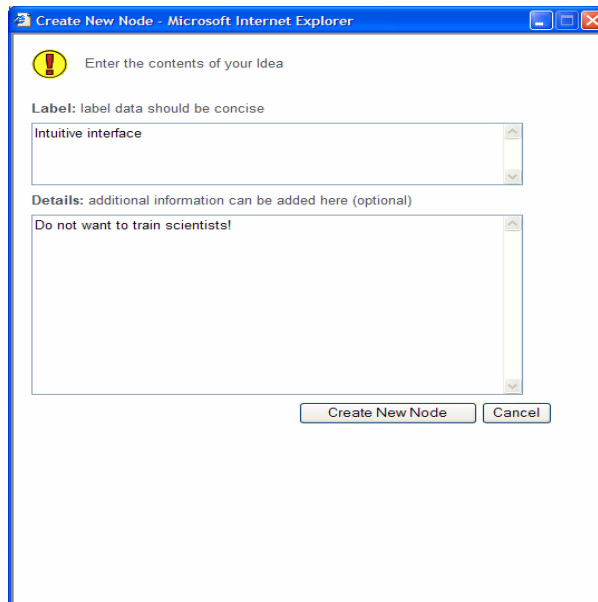


Figure 5 Add Answer Form

Microsoft Internet Explorer window titled "Create New Node - Microsoft Internet Explorer".

Enter the contents of your Reference

Label: label data should be concise

Project Situation/Target/Proposal document

Details: additional information can be added here (optional)

Attachment (associate a document with this node)

File:(upload a file from your workstation)

C:\TargetSelection\project_proposal2.doc [Browse...]

OR

URL:(refer to a document elsewhere on the Web)

[Create New Node] [Cancel]

Figure 6 Add Reference Form

4.2. Export Nodes

When the facilitator clicks on “Export to Web” or the reply process refreshes the web site map, a new export to web occurs. The facilitator version will export to the web the map tagged with DISCUSSION_MAPS_PARENT and all its sub maps in our modified html format. The browser user triggers the same request when they add a reply to the Web discussion. The web interface add reply node process will only trigger a regeneration of the html for map of the node to which they replied, not all its sub maps. To implement this feature, we changed the structure of the Exports directory on the server. (Figure 7)

The generation of the table of contents has also been modified to show only map nodes. Indentation is used to show map structure. The outmost map is the top level map. If a map is indented from the one above it, it is a child of this map. The new TOC can create duplicate entries because of the circularity of some maps. (Figure 8) One can navigate to a map by double clicking on the map node on the discussion, or by clicking on the table of contents label for that map.

The date and author information is very important to our intended web users so we made this information available on the mouse over of a node. (Figure 8). Mouse over of tags, transclusion node number and the asterisk representing the presence of details works the same way it does in the original Compendium, “Export to HTML”. For the count and list of transclusion nodes, we removed “Home Windows”, since Web users do not have access to Home Window views. Full details are still available by left clicking on a node. The details form comes up but with the added feature of a “Respond” button. This feature lets users reply to a node after reading the details, and without having to navigate back to the main map.(Figure 9) A new functionality we added to Web Compendium application is the ability to upload local files.(Figure 6) This feature is not yet available for the standalone facilitator. Either right clicking on a node, or replying from a full details page, generates a popup menu that shows a limited set of responses. This design decision was to prevent the untrained Web Compendium user from going too far from the IBIS

methodology. For example, one can not reply to an issue with another issue. This is a key way we get untrained participants to build IBIS style networks instead of the random maps we get when we hand out a full Compendium client. Another limitation, which we impose on Web users, is that they can not add map, list, argument or decision nodes. The decision to limit responses in this way made sense for our business needs.

One of the last but definitely one of the most important features we added to our generated version of the html discussion maps, was a drop down help and legend menu in the Table of Contents section. This was to allow our web users easy access to “how to” directions and the IBIS theory from the web version of Compendium. All help links target an internal wiki. The actual pages and tutorial movies linked to by the help menu are designed specifically for our application, and are not the original Compendium movies.

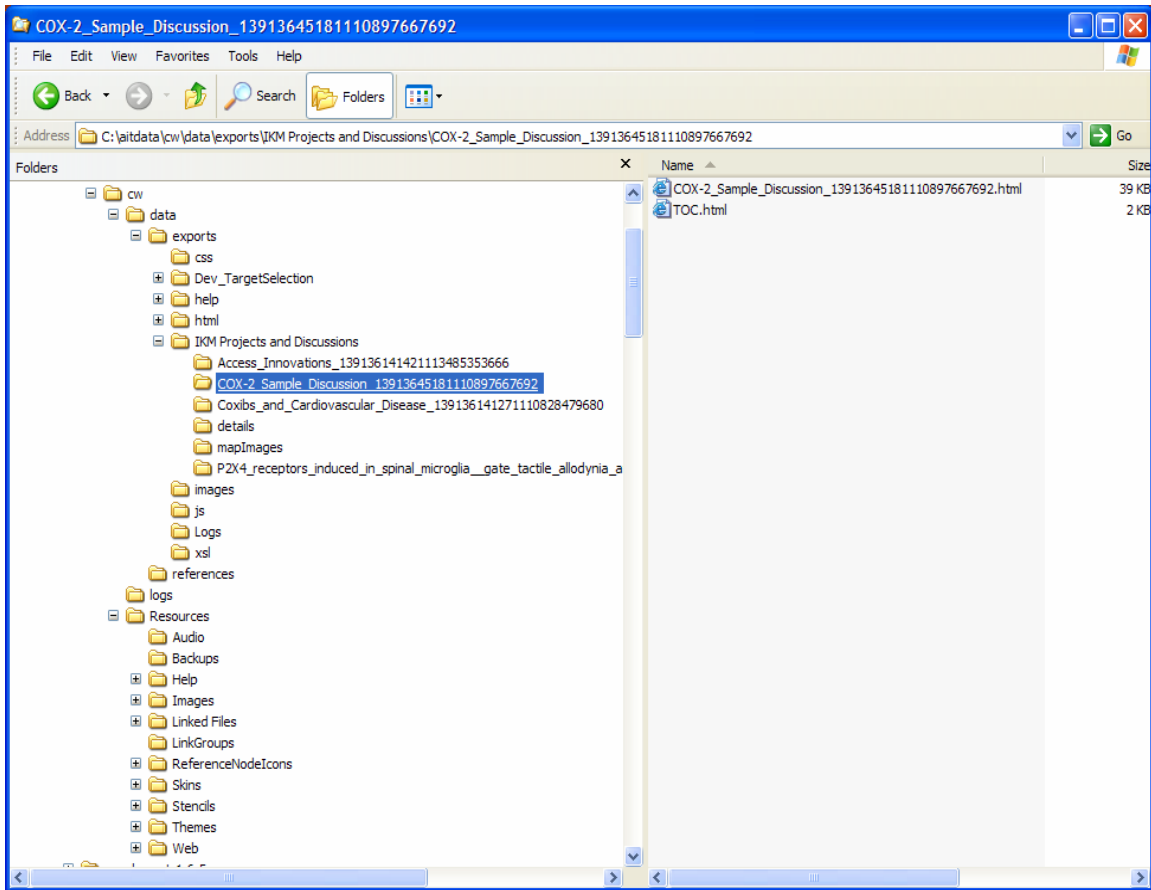


Figure 7 Directory Structure of Exports Directory

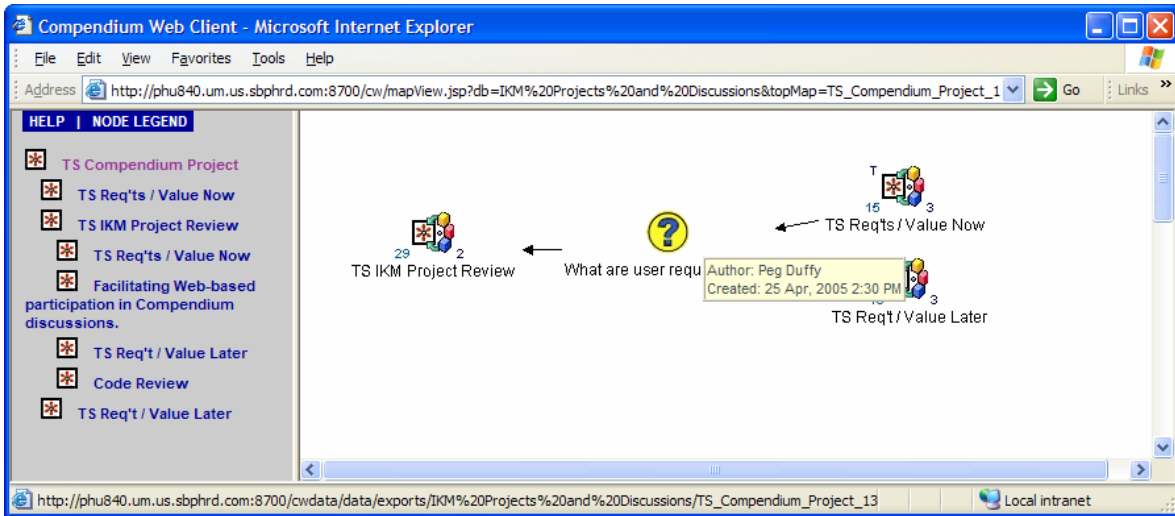


Figure 8 Index or Table of Contents Restructuring

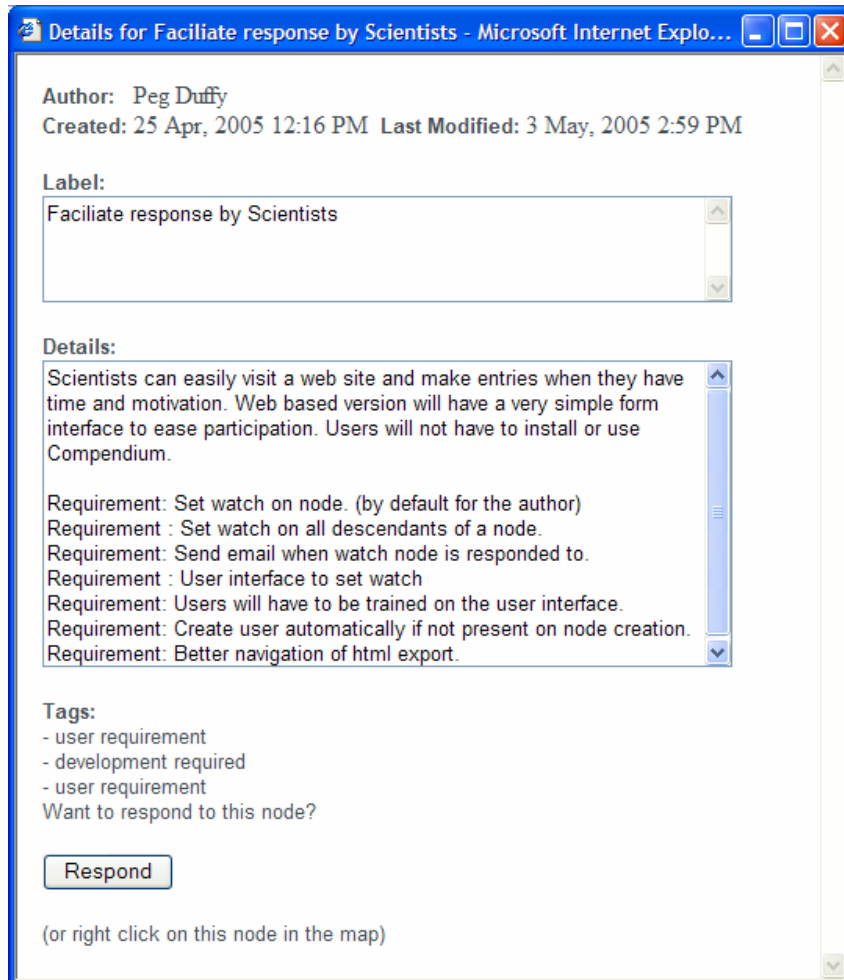


Figure 9 Reply from Details Form

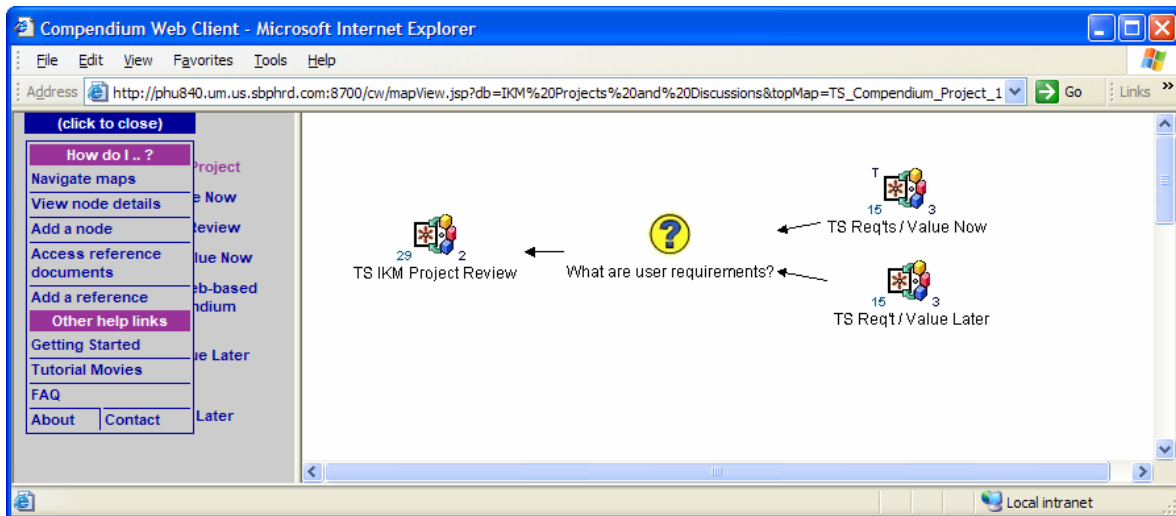


Figure 10 Help Menu

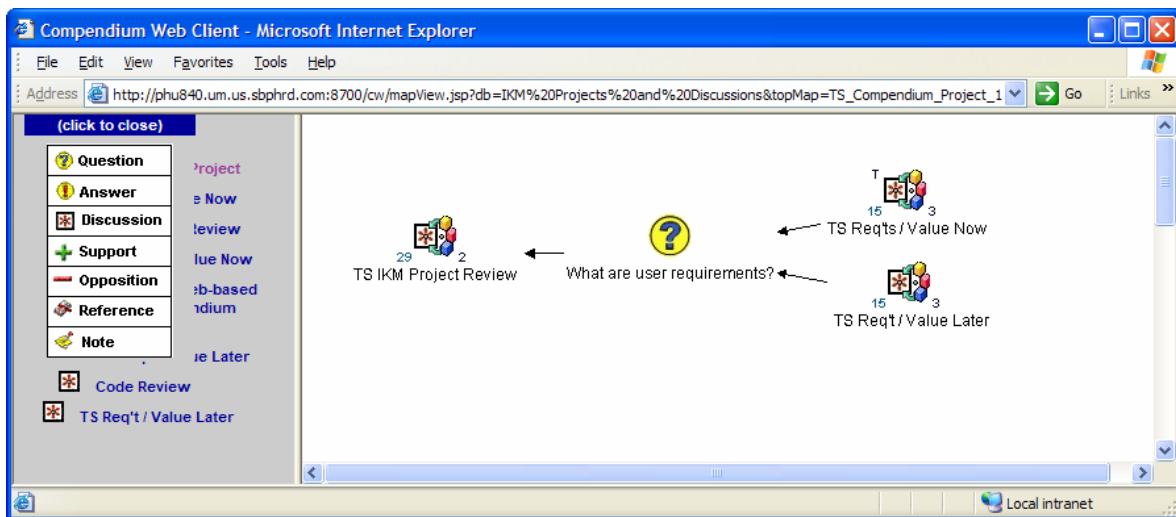


Figure 11 Icon Legend

5. Future Plans

If our users find this pilot valuable, future development may be required. The list of things we would like to do or that our users may want us to do fall into two categories; Facilitator Standalone Improvements, and Web Compendium Improvements.

Facilitator Standalone Compendium Future Development List

1. Add ability to upload local files to web server from the standalone facilitator version, if that map has the DISCUSSION_MAPS_PARENT tag or is a child of this map.
2. Use Oracle for Compendium's database backend, not MySQL.
3. Use Web Start for the delivery of new versions of the Standalone version. (Currently, a script is used to install this application from a shared drive.)
4. When the facilitator exports a map, email back to them the URL of the top level map, as well as the URL for each child map. Facilitators can send the appropriate URLs to the group of appropriate scientists.

Web Compendium Future Development List

1. Use divs not frames in the html. This will allow us to remove all the logic required by frames.
2. Refactor the JavaScript. Too many developers wrote their own functions.
3. Add the ability for the user to define their email preferences. They could receive email at top level, at a sub map level, or possibly at the node level. "If anyone replies to this node, alert me."
4. Add the ability for an author to modify their own nodes.
5. Create an automatically generated set of URLs or a table of contents page, for all the Target Selection discussions, on our internal wiki. (possible Web Service)
6. Automatically generate a text summary of each target discussion and place it on the wiki. (Possible Web Service). The summary page would allow easy searching and text mining.

6. Conclusion

The Compendium development for this pilot was done to accomplish one of the following goals:

- Minimize development cost of the pilot, until its internal value was determined.
- Facilitate scientist participation in Target Selection discussions.
- Do not require web users to invest much time in training to use Compendium or IBIS.
- Do not require web users to install additional software on their PCs.

An export to web facility was added to the original Compendium code. A version of Compendium, running on a web server was developed, allowing IE users to participate in Target Selection discussions from their PCs without the need to learn to use or install Compendium. We are currently monitoring the use of this pilot to determine its value to our users.

7. References

- (1) E. Jeffrey Conklin, PhD, and William Weil. "[**Wicked Problems**](http://www.touchstone.com/tr/wp/wicked.html) Finding and solving the source of pain in organizations using innovative approaches". <http://www.touchstone.com/tr/wp/wicked.html>.
- (2) E. Jeffrey Conklin, PhD. "[**The IBIS Manual**](http://www.touchstone.com/tr/wp/IBIS.html) A short course in issue-based information system methodology". <http://www.touchstone.com/tr/wp/IBIS.html>.

Filling in the Gaps: Enriching Compendium Maps with Integrated Audio and Video

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www.kmi.open.ac.uk/people/sbs / www.kmi.open.ac.uk/people/bachler

Abstract

In this presentation we will demonstrate and discuss some of the approaches we have been taking to integrate audio and video with Compendium representations. These range from recording just the computer's screen plus an audio feed, through to indexing video of co-located or online participants with event logs from Compendium's use. Experiences with these are described, with some initial reflections on how audio/video records may change the Compendium practitioner's mapping.

1. Introduction

In this presentation we will demonstrate and discuss some of the approaches we have been taking to experiment with recording audio and video with the use of Compendium. First, let us consider why one would want to add AV to Compendium maps?

1.1. Dialogue Maps as skeletons

A Dialogue Map is a skeletal representation of a meeting's process, which necessarily (and often productively) summarises contributions in a terser fashion than they are expressed. A Dialogue Map does not record everything, and does not normally communicate the serial nature of contributions, again usually productively: if discussion returns to an earlier issue, contributions may be added to that issue so that it is a summary of all discussion on that topic, regardless of time. For the meeting participants, the richness of everything else that is going on in the meeting – the 'flesh' on the skeleton – is self evident. However weeks or months later, that richness will have faded with memory and they depend on the skeleton as a resource to help reconstruct the original 'living creature' ("Ah yes, we spent 20 minutes down in this corner figuring out those tradeoffs"... "That was when Ann finally arrived with that killer spreadsheet"...). For people accessing a Dialogue Map who never attended the meeting, all they have is the skeleton, and they may even reconstruct a creature that did not exist.

Similarly, a set of maps resulting from Conversational Modelling or any other form of modelling may reveal very little of the process by which the final product evolved. Was a map simple or difficult to create? If such information is of interest – to replay for others; to catch up on a missed meeting; as a form of data for subsequent analysis – then audio and/or video of the meeting fills in the gaps left by the terseness of Compendium maps.

There is always a cost to capturing AV, even if once the hardware and software infrastructure is in place, this is subsequently considered small: AV data consume relatively large amounts of storage space, require relatively powerful computers both to capture without loss of quality and to subsequently serve the media, and there is always a 'social cost' to recording conversations, if only the possibility that it may be used subsequently in undesirable ways. The latter danger is an issue for organisational policy and mutual agreement – there will be very poor meetings if people are worrying about recordings.

Assuming the above factors are addressed, the rationale in which the additional cost of adding AV could be justified include:

- **Providing an engaging introduction, a guided tour, or detailed tutorial:** in these scenarios the AV is narrated, so the social sensitivities of meeting capture are not an issue.
- **To enable the recovery of detailed discussion which may be mission critical:** decision-making in safety-critical, security-critical or other high cost missions in which rapid decisions may be made under pressure and may need to be reviewed, or audited (e.g. space exploration, wartime decision-making, or disaster/emergency response)
- **To capture process data for research purposes:** the techniques below can be considered as research instrumentation analogous to ‘wired rooms’ used in other forms of video-analysis based research.

2. Screen-recording Compendium + audio

The ‘lite’ approach is to use a utility to record screen activity, plus audio captured from a microphone, which generates a movie file (eg. in Flash, QuickTime or AVI format). The movie can then be simply played, or skimmed by using the slider to fast forward/rewind until nodes of interest appear on the screen (Figure 1). Since everything on the screen is recorded, not just Compendium, other applications on screen can be used as a visual index.¹

The Compendium Institute instructional movies are an early example of our use of this approach to provide narrated introductions to maps.² We are also considering embedding ‘welcome movies’ in maps which guide the viewer through the structure of the database, drawing attention to important issues, decisions, arguments, reference nodes, etc. When the viewer may also become an author (e.g. when bringing a new team member up to speed), we would also consider highlighting the way in which other representational strategies or conventions are followed, such as tags, templates, transclusions, stencils and the flagging of action items.

We have added AV to Compendium in the Open University (e.g. in distance PhD supervision – as in Figure 1), while our Stadium³ webcast infrastructure introduces a technical variation to the same effect: use of Compendium to map discussions in a webcast research seminar⁴ or in a workshop plenary session⁵, can now be replayed as a streaming QuickTime movie, skimming the growth/decline of maps, plus whatever other applications were used, to find the relevant point in a discussion.

¹ TechSmith’s Camtasia Studio [www.TechSmith.com] is an excellent product to consider for Windows, and Ambrosia’s SnapzPro on MacOS X [www.ambrosiasw.com]. A web search on screen capture utilities shows free/shareware versions. Camtasia uses a codec designed explicitly for screen activity, provides post-capture editing tools (e.g. to add commentary bubbles to highlight key moments), and exports to different video formats, including the web-friendly Macromedia Flash. SnapzPro generates QuickTime movies, which can then be edited in free tools such as iMovie.

² Compendium Institute training videos: www.CompendiumInstitute.org/training/videos/

³ KMi Stadium webcasting: <http://stadium.open.ac.uk>

⁴ *Knowledge Art*, Albert Selvin, KMi Research Seminar, Open University: www.kmi.open.ac.uk/seminars

⁵ e-PhD Workshop, Open University, Feb 2005: www.kmi.open.ac.uk/projects/e-phd

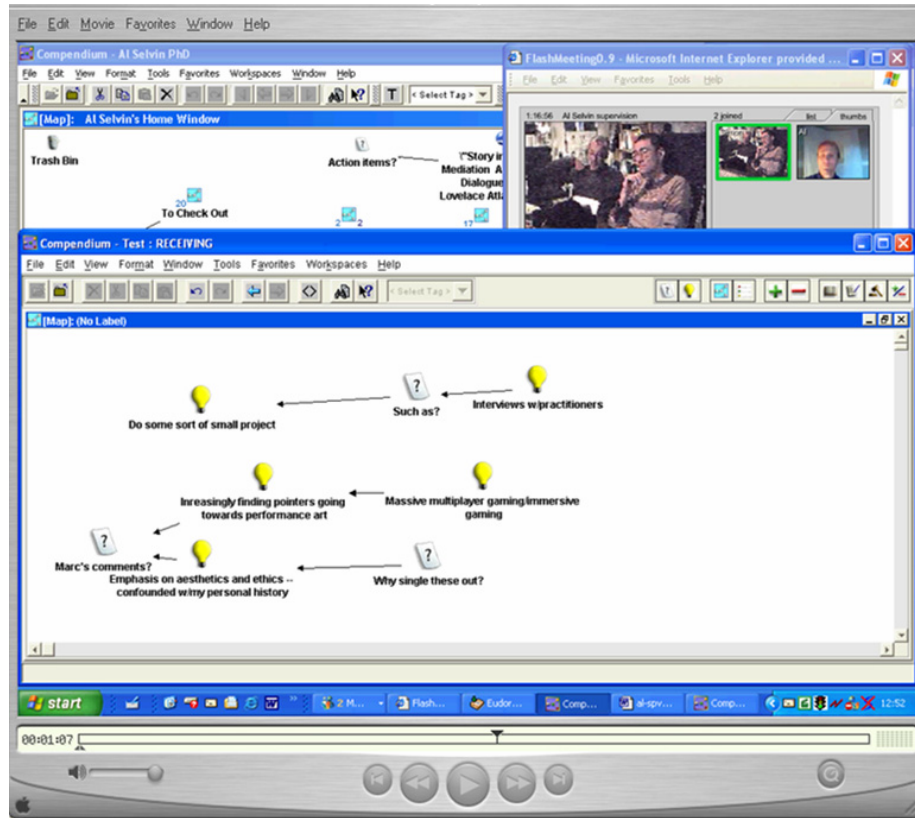


Figure 1: Replaying a movie of a Compendium-supported internet video conference, generated from a screen recording utility plus audio input. All screen activity (not just Compendium) is recorded, and the movie can be manually skimmed with the fast forward/rewind controls, using the timestamp + screen activity as a visual cue to the content of the discussion.

Screen recording was used extensively to augment phone conferences in supporting the NASA Mobile Agents project⁶, using WebEx to share the screen over the Web. All these sessions were recorded in Camtasia, with audio captured by placing a mic by the speakerphone so that it recorded all participants. This provided a rich video corpus for subsequent research analysis (see AI Selvin's presentation at this workshop on studying expert use of Compendium), and there was at least one occasion where one of the authors (SBS) missed a meeting and needed to catch up with it afterwards. In this field trial we did not have any other examples where team members needed to replay the movies, but in a real mission we anticipate the value of being able to recover a mission-critical discussion or decision for review by a superior, or in the event of a review.

As anyone who has experience with sound recording knows, in a face-to-face meeting the audio can be hard to capture (whereas over the internet or a phone conference it is mediated via a single, easily monitored channel). A good microphone is therefore recommended to capture all participants (e.g. a conferencing speakerphone with good 360 degree range can be used as an input mic to a PC).

⁶ Clancey WJ, Sierhuis M, Alena R, Berrios D, Dowding J, Graham JS, Tyree KS, Hirsh RL, Garry WB, Semple A, Buckingham Shum S, Shadbolt N, Rupert S. (2005) Automating CapCom using mobile agents and robotic assistants. *American Institute of Aeronautics and Astronautics 1st Space Exploration Conference*, 31 Jan-1 Feb, Orlando, FL. Available from: AIAA Meeting Papers on CD-ROM, and as AKT ePrint 375: <http://eprints.aktors.org/375>

While this ‘lite’ approach to screen+audio capture is extremely simple to use (the equivalent of pressing Record on a video recorder), but the tradeoff is that there is no machine-readable index into the movie. It must be manually skimmed using the resulting video’s fast forward/rewind controls, using the timestamp + screen activity as a visual cue to the content of the discussion.

3. Navigating meetings via Compendium and Meeting Replay

To address the need for machine readable indices into meeting records, in the context of the NASA field trial introduced above, a multimedia Meeting Replay extension to Compendium was developed to assist the indexing and navigation of the meeting videos to assist one team’s understanding of another’s meetings, decisions and rationale. The user interface of the prototype Meeting Replay tool is shown in Figure 2.

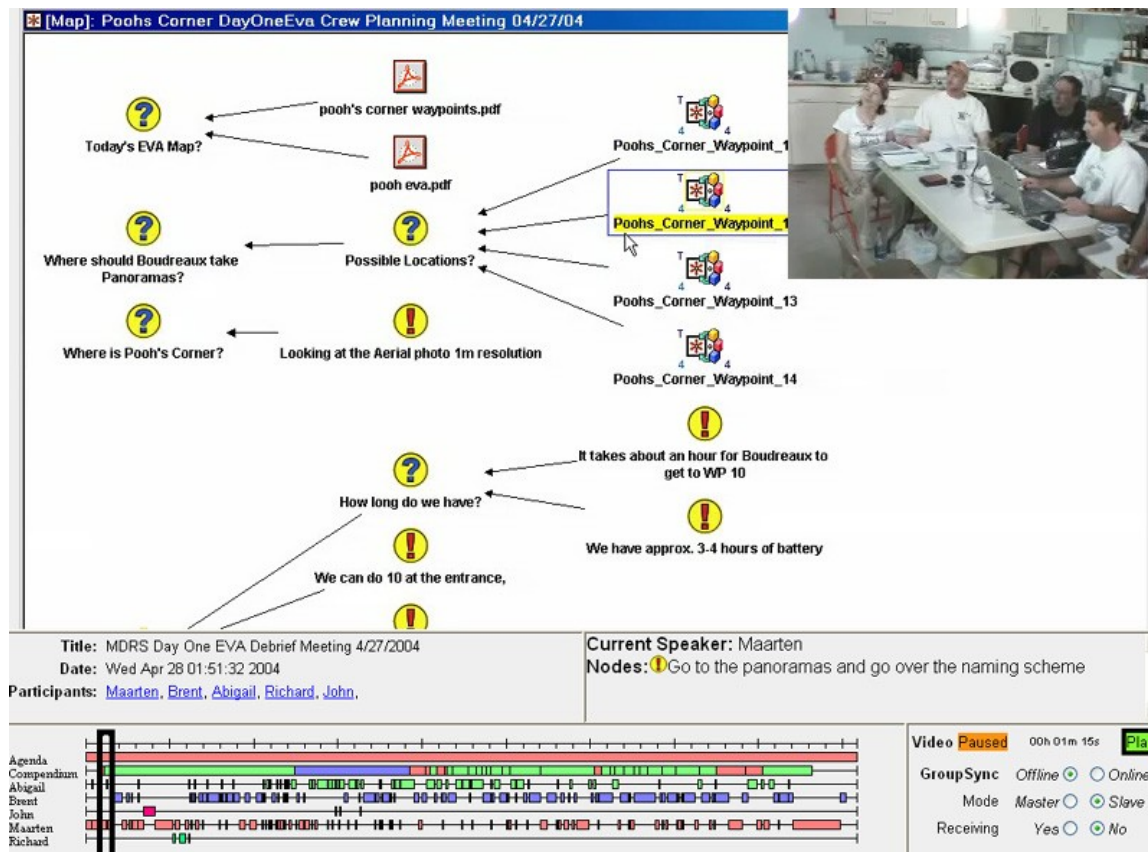


Figure 2. Compendium-based *Meeting Replay* tool to help the science team on Earth recover the rationale behind the Mars crew’s analysis and decisions.^{7,8}

The upper region of Figure 2 shows the video of the crew’s meeting inset into the Compendium map they are constructing. The lower region contains summary information about the meeting: who was there, who was speaking, the agenda, and an overview of the current topic (derived from

⁷ Developed by the University of Southampton and the Open University as part of the *CoAKTinG* project: www.aktors.org/coaktinG

⁸ Bachler, M., Buckingham Shum, S., Chen-Burger, Y-H., Dalton, J., Eisenstadt, M., Komzak, J., Michaelides, D., Page, K., Potter, S., De Roure, D., Shadbolt, N. and Tate, A. (2004) Collaborative Tools in the Semantic Grid. In *Proceedings GGF 11 Semantic Grid Applications workshop*, Honolulu, Hawaii. AKT ePrint 353: <http://eprints.aktors.org/353>

the Compendium map). Some of this information is presented as a timeline, providing a visual index for an RST member to navigate the video, jumping to relevant or interesting parts of the discussion by clicking on the timeline or moving the slider.

The Meeting Replay interface was generated by Perl scripts from a set of RDF files generated by the different event streams (agenda items, Compendium events, who spoke when) and delivered via a web browser using Java and JavaScript. Perl scripts converted. The RDF for who spoke when was manually coded, however, in this prototype, since we did not have the infrastructure in place to automatically detect this.

As well as being able to navigate using the event streams at the footer, Compendium was extended to support conceptual navigation: thus, to see discussion prior to the recording of a particular *argument*, one can click on this node in the Compendium client and the replay jumps to the point in the meeting shortly before that node was created (Figure 3).

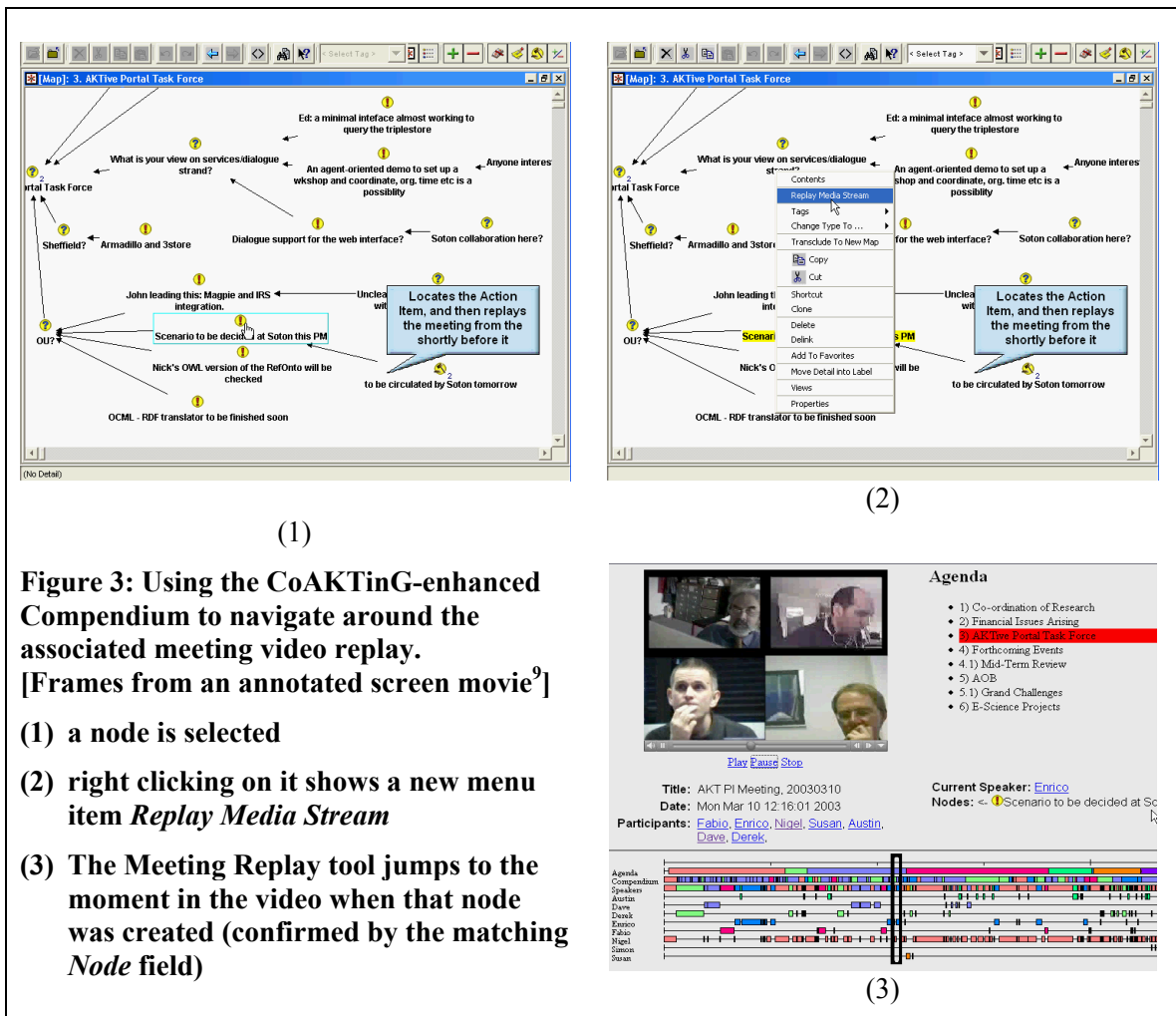


Figure 3: Using the CoAKTinG-enhanced Compendium to navigate around the associated meeting video replay. [Frames from an annotated screen movie⁹]

- (1) a node is selected
- (2) right clicking on it shows a new menu item *Replay Media Stream*
- (3) The Meeting Replay tool jumps to the moment in the video when that node was created (confirmed by the matching *Node* field)

⁹ CoAKTinG Demo Video - CoAKTinG tools in use during an AKT PI Meeting: www.actors.org/coacting/resources.html

3.1. Learning to read Meeting Replay visualizations

The key addition to basic video conference replay which the Meeting Replay tool brings are the interactive event timelines, providing a visual index to get an overview of the video, and navigate around it by clicking on an event. We are also in the process of enabling a different timestamp which can be added manually (e.g., if a node is created five minutes or even several days after a discussion, one would index it to the relevant point).

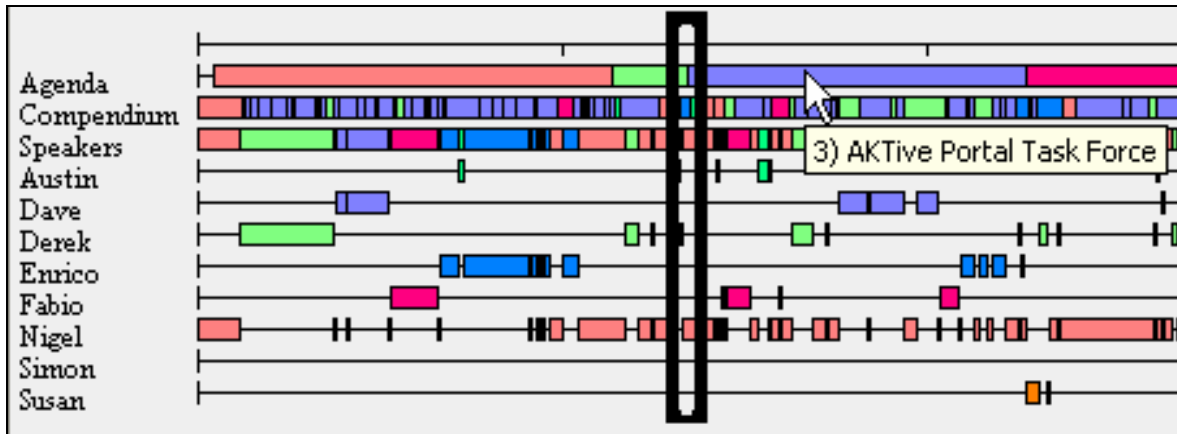


Figure 4. Meeting Replay's interactive event timelines. The black 'current point' slider can be dragged, or will jump to the location on an event line where the user clicks.

The following information, which is not normally accessible from a video, can be read from the event timeline visualization:

- Who spoke when
- Who spoke a little or a lot
- Who spoke about a particular agenda item (whose identity is displayed on a mouse rollover – see the figure)
- Who spoke about a particular Compendium node (again, whose identity is displayed on a mouse rollover). This node might be an Issue, Idea or Argument, or a Reference node to an external document such as a spreadsheet, website, photo or slide (see Figure 2)
- What the distribution of Compendium node types is (they are colour coded by type)
- Combining the above, which agenda items or Compendium nodes provoked a lot of discussion, with an approximate indication of whether there was much argumentation (presence or *Pro*, *Con* and *Argument* nodes)
- Who arrived late in the meeting might be signalled by the onset of contributions late in the meeting

There is an additional cue provided during navigation around the replay, e.g. on clicking a timeline event or Compendium node. When one jumps into the middle of a video recording, for someone who was not at the meeting or who has forgotten the details, there is an orientation phase while one establishes the context. The Meeting Replay interface offers the user a cue to the context by displaying the 'current' (most recently created) Compendium node (in Figure 2, see the node icon and label under *Current Speaker*). Thus, in addition to whatever may be on the main display and under discussion, one is also cued to the last *Issue*, *Idea*, *Argument*, *Reference node*, etc. The user is, however, left to disambiguate whether this node may have *motivated* whatever is currently happening in the video, has *arisen* from it, or indeed, is irrelevant and pertains to something no longer under discussion.

3.1.1. Navigating Conversations Spanning Multiple Meetings

A second affordance that we have yet to implement in Meeting Replay, but which we are beginning to consider, is navigation of conversations spanning *multiple* meetings. This is already possible in Compendium, whereby maps from discussions going back years can be retrieved (based on keyword, date, node type, author or metadata), and pasted into a current discussion. In addition, past nodes can be actively cued by the interface through auto-completions of a new node's label based on matches to existing nodes (which might come from years back). Once these nodes are linked into a Meeting Replay archive, it would be possible for the user to select from multiple Meeting Replays in which a given node has arisen. Similarly, a search on the Compendium database will in effect be a search across multiple video conferences.

The Meeting Replay semantic web architecture uses an RDF triplestore to represent the contents of meetings, and from which the Meeting Replay interface is generated. This opens up further possibilities for reasoning over multiple conversations, which we have yet to investigate.

The technical feasibility and initial usability tests from the CoAKTinG project's proof of concept Meeting Replay were sufficiently promising that we wanted to continue the work on a more robust basis in order to properly understand its potential, as reported next.

4. Making it robust: CoAKTinG-enriched Access Grid

Work is now under way in the *Memetic* project¹⁰ to develop this infrastructure into a standard part of the video conferencing infrastructure offered by the *Access Grid*. The Access Grid (AG) is an open collaboration and resource management architecture for video conferencing, document and application sharing, based on the metaphor of persistent virtual venues. A commercially supported version is available as *inSORS*.¹¹

An AG meeting can be attended from a full AG 'Node', a designed space consisting of a large display screen and good quality, full duplex audio; from a 3-screen 'Office' AG node, which can be sited on a desk; or from a single personal computer (Figure 5).

The Memetic project is integrating the Access Grid, Compendium and Meeting Replay. The scenario we are working towards is that an AG meeting is booked via a website, specifying participants, agenda items and any URLs of background documents for discussion. Compendium connects to the server, loads the meeting metadata as an agenda map, and when the meeting starts, goes into *Record Mode*, generating a time-synchronised event log as it is used (e.g. as in Figure 6), which is then uploaded to the server.

Event logs are captured from the augmented AG infrastructure, including which site is speaking, which slide if any is being shown, which screen(s) if any is being shared, which Compendium node/view is active, and possibly other machine detectable events of interest. We plan to investigate the idea of generating custom event timelines in the Meeting Replay interface based on combinations of node types and tags that a given user group might define for themselves. A script integrates all the event logs and generates a video conference replay, automatically indexed with event timelines. A meeting can also be annotated retrospectively in Compendium when it is taken into *Replay Mode*, in order to insert new indices to significant moments (this opens the

¹⁰ The *Memetic* project: Meeting Memory Technologies Informing Collaboration: www.memetic-vre.net

¹¹ inSORS Integrated Communications : www.insors.com

possibility of using Compendium as a video analysis tool, with one or more layers of visual annotation using node types, stencils and tags to express coding schemes).¹²

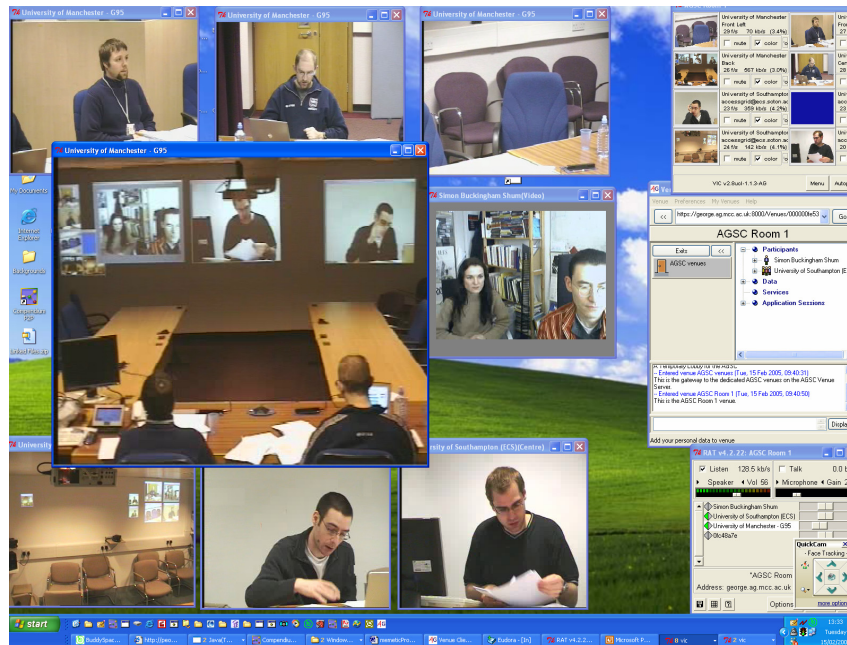


Figure 5. Participating in an Access Grid (AG) video conference from a personal computer. The enlarged central video window shows participants in a full AG Node room, and the three aligned wall projections which they can configure.

¹² Compendium's data structures have been extended to support this scenario including a Media Index time for every node, which specifies the video time it should be associated with (editable from the default node creation time), plus mechanisms for connecting to a meeting server, importing its metadata, and uploading the event log file. Future technical papers will specify the architecture of this environment in detail, which is not the focus of this paper.

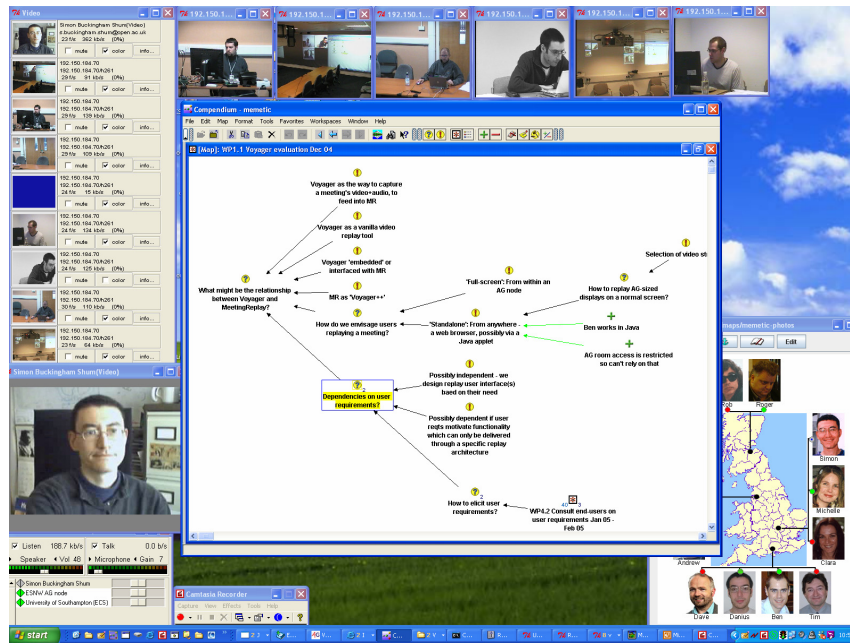


Figure 6. Mapping an Access Grid (AG) video conference in Compendium. In ‘record’ mode, Compendium is connected to the AG meeting server, with a synchronised timestamp so that events can be integrated with other event logs from the meeting. At the end of the meeting, the event log is uploaded to the meeting server, as an input into the Meeting Replay. In ‘replay’ mode a video can be annotated post-hoc with nodes.

5. How adding audio/video might change Compendium practice

Deployment and evaluation of Memetic tools with our end-user partner organisations starts in January 2006. The results of these trials may well shape the way in which the Compendium mapper operates, once s/he is aware of the new affordances maps take on when placed in the role of video index. However, we have now had sufficient experience in mapping during audio/video recording to describe some initial patterns:

- Firstly, the fact that audio/video are being recorded may serve to relieve some of the pressure on the Compendium mapper – if something is missed it can be recovered later and inserted. However, this is more of a safety net, since it does not relieve the practitioner of the real time responsibility to reflect back to the meeting the ideas being contributed.
- Secondly, knowing that a node’s creation date (which is the default Media Index time) may be used to navigate to that point in the video places a premium on creating a node reasonably soon after someone starts to speak, and then changing its type and Media Index later if required. Different mappers may have their own styles, however, which can be accommodated to a degree by varying the latency in the Media Index. One mapper might set it to be 10 seconds before the creation time, another 5 seconds. Overestimating the latency is a safer approach, because it will simply take the viewer to a point in the video shortly before the creation of the node, which establishes useful context.
- We anticipate from current Compendium practices (quite independent from whether audio/video are being recorded) that the mapper will want to insert new nodes into a map after the discussion has moved on. Often during quiet moments in a meeting, a mapper

will clean up, edit or amplify a map. We have therefore designed the facility to select a node, and assign its Media Index to others.

- Finally, if tags start to assume a new importance as the basis for event timelines, then tagging will need to be done as quickly and accurately as possible, possibly encouraging the use of user-defined Stencils to ‘preload’ nodes with the relevant tag profiles, or raising the need for keyboard shortcuts or toolbars to quickly assign predefined tags.

6. Conclusion

The integration of audio and video with Compendium introduces a new dimension to Dialogue mapping, and collaborative modelling more generally. This can range from a very simple infrastructure comprising screen recording+audio feed, which can generate a movie from a face-to-face meeting, phone call or video conference, through to the more sophisticated internet video conferencing capture and replay we are adding to the Access Grid in the Memetic project. We are almost at the point of being able to deploy the tools with diverse user groups in the Memetic project, in order to study what they make of them.

7. Acknowledgements

This paper has focused on Compendium, but many others have contributed to the other enabling technologies with which we are integrating. We gratefully acknowledge the funding of the EPSRC [CoAKTinG Project](#), the JISC [Memetic Project](#) and the ESRC [ECOSENSUS Project](#) which have contributed to Compendium’s software development. We acknowledge our partners at Southampton University for their work on Meeting Replay (Ben Juby, Danus Michaelides, Dave De Roure, Kevin Page) and at Manchester University for their work on Access Grid (Michael Daw, Andrew Rowley).

Using Compendium to Facilitate the Strategy Conversation

Julisa Espinoza, Dil Chowdhry, and Tara Carcillo

Touchstone Consulting

Touchstone Consulting helps leadership teams design and implement their strategy. To help keep the group aligned, Touchstone has used a framework, called the Gameboard, along with Compendium to facilitate some of these sessions. In this session we will:

- Review client examples of how they have used Compendium to facilitate this strategy conversation
- Explore why Compendium is useful in these strategy conversations
- Provide participants with an experiential learning opportunity
- Equip participants with tools & techniques to facilitate their own strategy conversations

Communication Design: Understanding the Unintended and Unanticipated Shaping of Decisions, Disputes, and Learning Through Communication

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Abstract

The range of matters that could be discussed in any decision, dispute, or learning setting is vast but participants typically find themselves, for better or worse, addressing some particular range of matters in these settings. How this happens and with what consequence for the content, direction, and outcomes of decisions, disputes, and learning has become a focus in my research. In examining this question, I am interested in the artifacts, techniques, procedures, technologies, and roles used to shape communication. I am particularly interested, however, in how the tacit dimension of communicating and the unanticipated by-products of interaction unintentionally shape the content, direction, and outcomes of decisions, disputes, and learning. The ultimate purpose in addressing this at this workshop is to better understand the opportunity Compendium - software, methods, and uses - affords for addressing these specific issues and for advancing practical and theoretical understanding of intervention on decisions, disputes, and learning.

1. Designs for Shaping Discourse

While I am very much interested in several practical applications of Compendium in the research and university environment, I am particularly interested in how Compendium may provide a tool, an approach, and a community of practice for examining and explaining two related phenomenon: (1) how the substance of decision-making, disputing, and learning activities evolve and (2) how the discourse of decision-making, disputing, and learning can be intentionally shaped and directed.

My research has focused on the artifacts, techniques, procedures, technologies, and roles used to shape communication for decision-making, disputing, and learning. All of these are intentionally designed or practiced to foster particular forms of communication, while avoiding other forms of communication, that will lead to preferable outcomes. This is best illustrated in two studies of mediators by a colleague and myself where we focus on the basic tools of mediation practice: questions and summaries. These two studies show how mediators shape the disagreement space among the parties and how mediators articulate types of dialogues for pursuing the conflict.

Mediators manage impasse by shaping the disagreement space. While mediation practice is organized around producing consensus and cooperation amongst disputing parties, it is the articulation of disagreement that lies at the heart of what mediators do (Aakhus, 2003). Mediators shape communication by identifying what it is worth having a disagreement about.

While mediators are understood to be neutral, their neutrality is enacted in different ways and this is consequential for what and how the matters at hand are discussed. We identified three different models for managing discussion that mediators implement through their use of questions and summaries: critical discussion, bargaining, and therapy (Jacobs & Aakhus, 2002). Thus, mediators reconstruct disputes into plausible forms of interaction among conflicted parties through their use of questions and summaries but each form of interactivity constructs different opportunities for pursuing and managing the conflict.

Mediation practice reveals techniques and models for reconstructing contexts into interaction. At the same time, it is possible to see something similar in the design of information and communication technology.

Groupware technology can be characterized by its affordances for interaction and, in particular, argumentation. By examining the different groupware technology it is possible to see how these technologies vary in terms of their implicit models for reconstructing contexts into particular forms of interaction. Comparing technologies to the ideal of critical discussion reveals at least three models of reconstruction for handling complex problem-solving: funneling (e.g., group decision support systems), issue-networking (e.g., questmap), and reputation management (e.g., experts exchange) (Aakhus, 2002).

2. Tacit, Unintended Shaping of Discourse

Mediators and groupware are just two examples of a broad array of designed approaches for shaping discourse to accomplish some goal or range of goals. Designs for discourse abound in the modern world. However, despite the design of these solutions for shaping and directing discourse, discourse in decision-making, disputing, and learning takes a life of its own. The shaping of discourse is subject not only to designed, prescribed interventions since communicators orient to and articulate the content and direction of discourse in emergent, ad hoc, and improvisational ways. Ways that are often beyond the direct control of any participant but exploitable by any participant. How this happens and with what consequence for the content, direction, and outcomes of decisions, disputes, and learning has become a focus in my research. I am particularly interested in how the tacit dimension of communicating and the unanticipated by-products of interaction unintentionally shape the content, direction, and outcomes of decisions, disputes, and learning.

One way that I can exemplify this is to briefly describe my experience with creating and implementing tools to support reflective learning. The project aimed to provide a space for people to surface and test their assumptions about work and professional practice (Aakhus, 2005). I made my best efforts to design an approach that would support reflection on practice. The essence of the approach was the creation of online tools that enabled participants to make contributions to a database. The database enabled the construction of a record of accounts about the domain and problems of interest and responses to those accounts. The approach worked and sometimes worked very well as participants made many contributions to the online discussion and made use of the record of that discussion to write analytic-reflective essays about the nature of work and professional life. What became interesting, however, was the formation and construction of the record itself (Aakhus, 2004).

This was evident, for example, in the use of the application to support reflective learning among college interns. What I noticed was how the main contributions would sometimes appear to be shaped by the anticipated response the contribution might get. A common form of advice given in the online discussion was “go talk to your boss.” What would happen is that student participants would describe dilemmas they experienced at work, how they understood them, and handled them but they would produce these accounts to avoid that standard advice. That is an example of a tacit dimension of communication shaping the content of communication.

The reflective learning project reveals something about what is probably inevitable in attempts to shape and direct discourse: The range of matters that could be discussed in any decision, dispute, or learning setting is vast but participants typically find themselves, for better or worse, addressing some particular range of matters in these settings. Yet, it also seems that knowledge of these processes could also be better understood and provide a resource or inspiration for better intervention and technology support. I am here to engage in that discussion.

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Compendium as a Sensemaking Tool in Personnel Recovery Missions

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Abstract

This case study illustrates our use of Compendium to support a personnel recovery planning cell as they seek to resolve a simulated hostage scenario. Compendium was used as the primary sensemaking support tool, which through a combination of real time Dialogue Mapping and pre-mission Conversational Modelling proved capable of integrating both hard and the soft information, with expected and opportunistically arising content.

1. Introduction

We are, sadly, becoming all too familiar with news from conflict zones around the world reporting the capture or isolation of both civilians and military personnel. The Personnel Recovery agencies in different countries are responsible for deciding what to do in such situations. In today's world, it hardly needs emphasising that actions taken by one country within another can have complex political effects, which may even exacerbate the situation. A critical issue for Personnel Recovery research is, therefore, to investigate tools which can help assess the 'messy impacts' of candidate courses of action, especially when interventions may be by other than military means – using diplomatic, social or economic routes for example. There is then the need to follow through to execute the chosen plans and adjust them as circumstances alter.

The Co-OPR project (Collaborative Operations for Personnel Recovery) integrated two decision-support tools in a realistic personnel recovery mission, focusing on exploiting the respective strengths of human and software agents in the planning cell:

- **Compendium**¹: Hypermedia concept mapping tool to support real time, collaborative sensemaking and group memory by linking argumentation and information; uses an extended version of the IBIS² (Issue-Based Information System) notation for raising issues, options and arguments.
- **I-X**³: Intelligent collaborative command, planning and execution support to assist in creating options and accounting for procedural knowledge and planning constraints; uses the <I-N-C-A>⁴ underlying model for sharing issues, activity nodes, constraints and annotations.

These tools were deployed in a realistic, detailed personnel recovery scenario specifying political, historical, geographical and resource constraints on a UN peacekeeping operation. Commanders, ambassadors, political analysts and other stakeholders role-played the chain of command from US Secretary of State down. As we will illustrate, Compendium was used as the personnel recovery planning cell's primary information visualization, capturing the issues, options and arguments in real time, linking them together through a set of custom designed templates to support a crisis action planning methodology, shared synchronously with online team members via a collaboration environment. I-X was used to support more structured problem solving, proposing options using its knowledge base of Standard Operating Procedures (SOPs) and allowing those to be adjusted to account for issues raised by other members of the planning cell.

Issues, options for activities, and constraint information were passed between Compendium and I-X during the process. Feedback from external evaluation experts, brought in to assess the impact of the tools, confirmed that Co-OPR was highly rated by the military planners, with potential for further development.

The remainder of this paper summarises the Compendium aspects of this project. The I-X work and integration with Compendium is the subject of a fuller paper (under review).

2. Personnel recovery experiment

The context of the Co-OPR project is the US DARPA program's DIME effort to expand *Military* decision-making to take into account the wider (but 'messier' and harder to model) *Diplomatic*, *Informational* and *Economic* dimensions to actions. It was in this context that the Co-OPR toolset appeared to hold potential, given the range of factors which it could model, reason about and render as decision support. Compendium can bring together diverse sources of information and constraints within a common visual space. After initial internal trials on preset scenarios ('Experiment A'), Co-OPR was used in 'Experiment B' on 15-19 November 2004 at the US Joint Forces Command (USJFCOM), Sussex, Virginia.

The experiment involved an "aided" planning cell of human planners and analysts, supported by a number of planning and decision aids which were being evaluated for their effectiveness. Another "unaided" planning cell worked concurrently without the aid of the systems under evaluation. Co-OPR was used as a collaborative planning aid for the "aided" planning cell, dealing with a personnel recovery (PR) event in a fictional training scenario which specified in some detail the history of the countries between which tensions were rising, the logistical support available, and the political, economic and information infrastructure which the planners and supporting analysts had to negotiate and exploit in dealing with the hostage situation.

A range of publicly available sources was used to model the Decision Making, Doctrine and Standard Operating Procedures relevant to Personnel Recovery.¹³ These were modelled in both Compendium (as templates of issues to consider, extracted from the documents) and in I-X as Standard Operating Procedures. The Crisis Action Planning methodology that the planners were going to use was disseminated originally in advance of the experiment, and modelled in Compendium as a series of issue templates through which the team could step through systematically. However, when the methodology was changed an hour before the experiment started, it was straightforward to generate a new set of issue templates ready for the team when they arrived.

3. Compendium's roles

Compendium can be thought of as a generic 'horizontal' tool which spans many potential domain of application, which can be specialized for a custom 'vertical' applications domain in various ways (analogous to Excel, in this sense). In this project, it served as a tool for the rapid construction of a task-specific knowledge management environment, with specific emphasis on supporting *collective sensemaking*: the bounding of ill-defined problems, discovery and management of complex connections between ideas and data, and integration of potentially diverse perspectives.

Compendium was customized in several ways in order to provide the following representational scaffolding for the planning cell:

¹³ See the Experiment B report for details: <http://www.aii.ed.ac.uk/project/co-opr/expt/>

- **Customization:** Graphical map backgrounds which structured the space into matrices, pre-populated with translucent map nodes (also with custom icons) to provide navigational support.
 - **Application:** Created a set of interlinked *Crisis Action Planning* issue-templates, including wargaming analysis worksheets each for a different Course of Action (COA), which led to a summary comparison worksheet of all the COAs.
- **Customization:** Issue-templates from documentation.
 - **Application:** Large amounts of documentation were analysed in advance, in order to extract the required procedures ('doctrine') which planners are meant to follow, which were then rendered as Issue templates (what issues to consider in a given situation). These were then used to capture in real time the ensuing discussions and decision rationale as Dialogue Maps.
- **Customization:** Simulated integration with other intelligence databases (there was not resource in this exercise to implement the integration).
 - **Application:** Data in spreadsheets from other databases was dragged and dropped in to Compendium, which converted them into templates, so that the data could be tagged, translucented, discussed, etc.
- **'Customization':** Compendium was broadcasting the maps from the planning cell to a distributed team of analysts and advisors, connected via a collaboration workspace.
 - **Application:** Diverse inputs from planners and geographically distant political analysts were captured and interlinked within Compendium, creating a real time working memory, but also a long term memory resource.

We now illustrate in more detail the form that the above customizations took within the Personnel Recovery application that was built on Compendium.

3.1. Information integration for decision making

Compendium's role was to enable planners and political analysts to link to relevant information from any source, which should be taken into account in making a decision. One form this took was representing PR 'doctrine'. We were able to model aspects of personnel recovery doctrine, that is, the recommended or mandatory practices to follow in a given situation, as issue templates. Key issues, options and criteria to consider were extracted from source documentation, and linked into the planning templates. By representing them as granular 'knowledge elements' within Compendium, they became accessible from any map, and could be linked into any discussion (Figure 1).

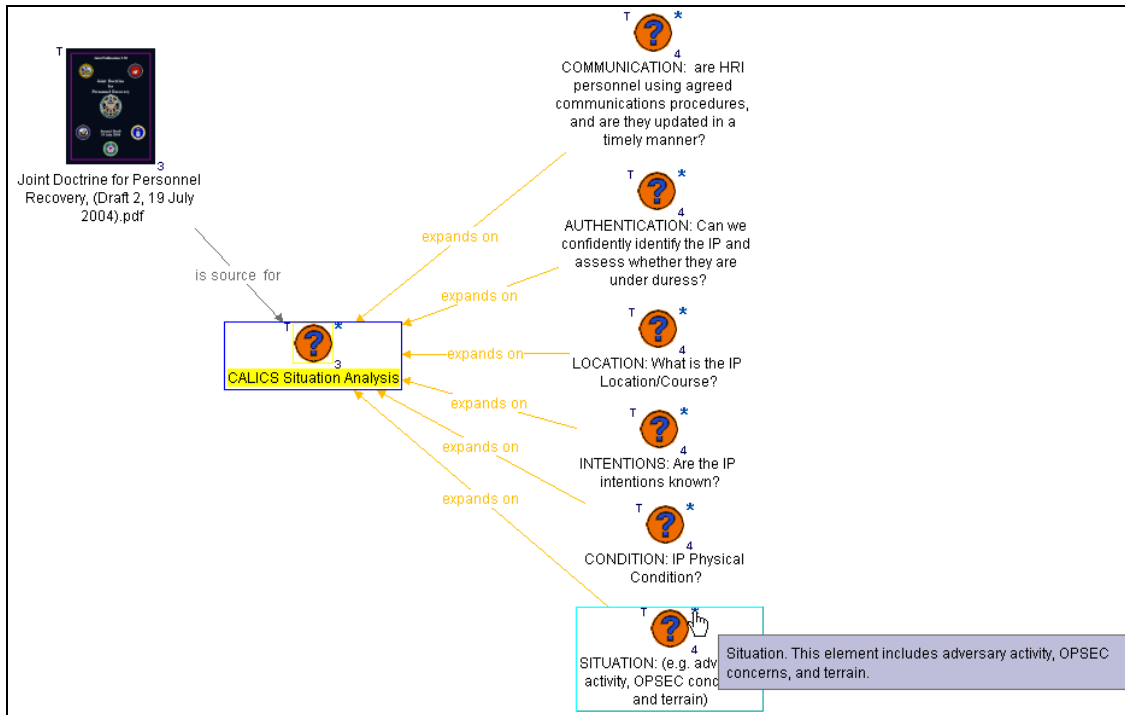


Figure 1: Mapping personnel recovery doctrine as an issue template which can be linked into COA/DIME analysis discussions as required.

Similarly, one would expect an integrated decision-support environment to include connections into all relevant intelligence databases. Although there was not scope to implement interoperability, one can 'drag and drop' data from Microsoft Excel spreadsheets into Compendium, which are then rendered as issue templates. Figure 2 illustrates how this was done to show data on the military forces in the region.

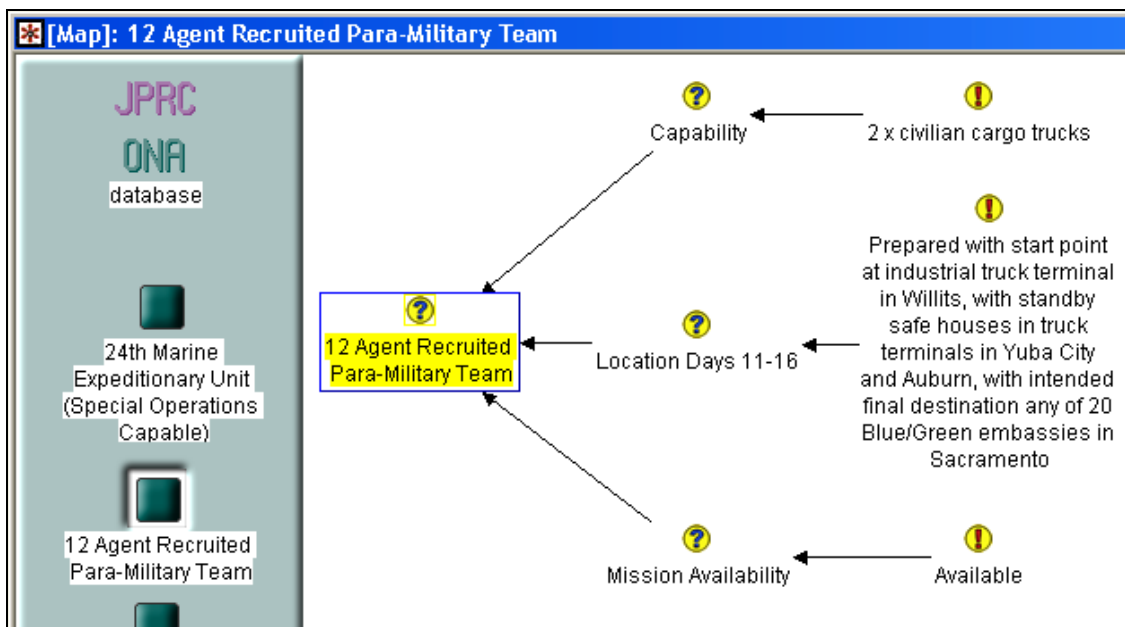


Figure 2: Mapping the contents of an external database as nodes which can be linked into COA/DIME analysis discussions as required.

Again, once information is imported into the hypermedia tool, it can then be linked into one or more discussions as required, further enriched with notes, and tagged with metadata (e.g. we created a *Unreliable Intelligence* tag to track all information about which there was doubt, and harvested all these nodes into a single view for ease of inspection).

3.2. Real time Dialogue Mapping+Conversational Modelling

Our own experiences as the tool operators supporting the planners and analysts in this experiment suggest that in the hands of a trained user, Compendium performed well as the team's primary working representation under intense, sustained time pressure. The Dialogue Mapper was able to support the planning team without disrupting their work, maintaining maps which were displayed at the front of the planning room, and shared digitally with remote members of the team who could hear the discussions orally, and see the contributions as they were added in Compendium.

The following extract illustrates how the collective intelligence of the co-present planning cell, plus online political analysts, was pooled to create a structured, but not over-rigid, mission memory. Figure 3 shows an example of a custom Compendium template to support a Course of Action worksheet, in this case, exploring options for a non-military coalition COA to recover the hostages. This grid layout was derived from interviewing a domain expert on the representations normally used by planning teams (on paper or in generic office tools).

The dock at the top displays links to the JPRC (Joint Personnel Recovery Center) mission briefing, relevant maps, three kinds of doctrinal issue template (as introduced in Figure 1) and the constraints/restraints earlier established (these nodes are also linked back to the discussions about these).

The main grid shows the start of an analysis with the three highlighted nodes representing three possible options recommended by the political analysts (accessible online to the planning cell). The first of these considers applying political pressure on a member of the fictional hostage-holding government, named 'Cebesoy'. Detailed analysis of this option was mapped in the Dialogue Map in Figure 4.

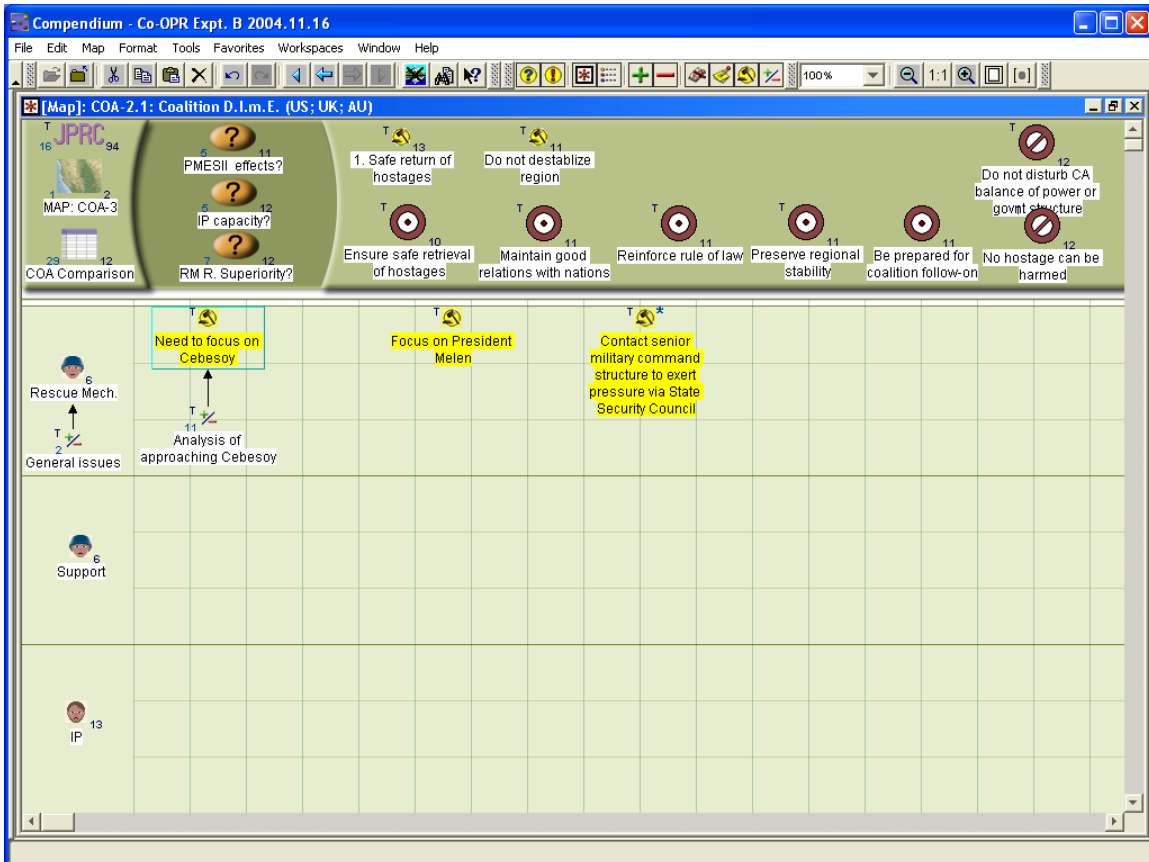


Figure 3: A worksheet to analyse a possible Course of Action (COA). The first option was: *Need to focus on Cebesoy*, a cabinet member of the fictional government holding the hostages. The details of this idea were then explored (Figure 4).

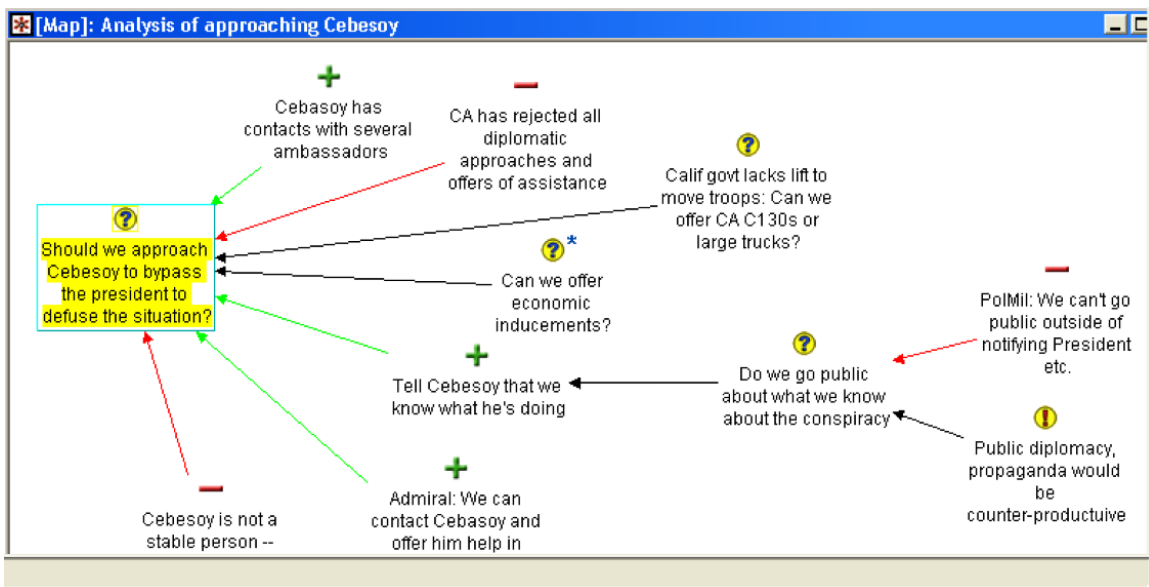


Figure 4: Issues, sub-issues and pro/con argumentation about how to apply political pressure to “Cebesoy” (expanding on the option in Figure 3).

A worksheet for each COA was developed, and then they were all compared against the key mission objectives (Figure 5).

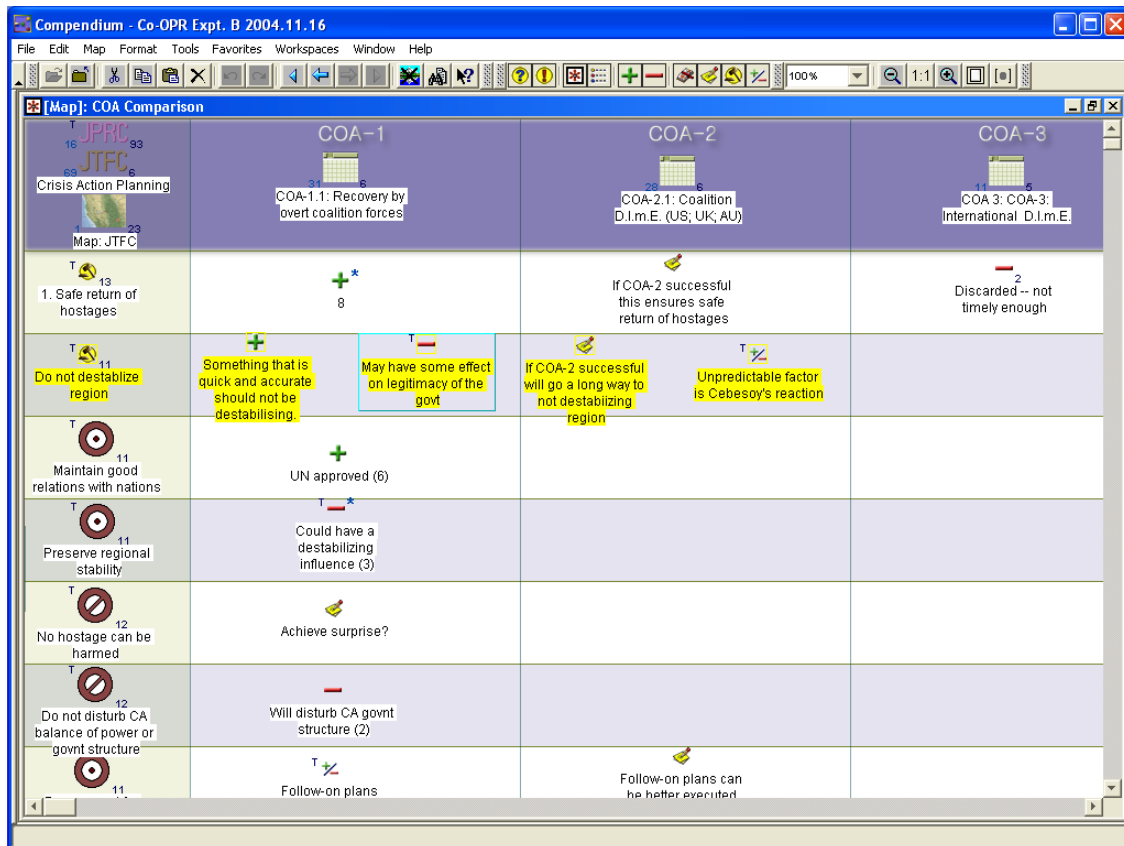


Figure 5: A COA comparison matrix, assessing all the COAs against the key mission objectives. All nodes are linked back to the individual COA worksheets.

4. Conclusions

To summarise, the following specific results were achieved during Experiment B:

- Compendium aided the Plans Director by integrating both informal and formal factors from COA and DIME analysis, in the process generating a structured group memory.
- Compendium was so effective that in the subsequent vignette of the scenario (in which Co-OPR was not due to participate) we were invited to replace the 'PowerPoint mapper'.
- Although not illustrated in this paper, Compendium was able to take data graphics from other tools being trialled in the scenario, for annotation with IBIS nodes, e.g. to raise an issue over a visualization.

A semiformal representation for issues, options and arguments, supported by a hypermedia tool for visualizing the relationships between these and other knowledge elements (such as data from other tools), was well suited for human sensemaking in this domain. The knowledge-intensive activity involved in DIME analysis of COAs required the capture, structuring, analysis and integration of many kinds of issue, ranging from formal/hard logistics (e.g. "How long will it take a helicopter to get from A to B?"), to the more open ended, informal issues that are inherent in such discussions (e.g. "Do we go public on what we know about the conspiracy?"). Options for answers to the former class of question could be proposed by more structured planning/simulation

tools, such as the I-X planning tool introduced at the start, but ultimately it was the human planners who made the final judgements, and there were often issues which only human expertise and wisdom could address.

The above pattern accords with our experience in supporting collective sensemaking in many other domains.⁹ Compendium provides a medium in which all factors under consideration can be laid out in a common space, relieving individual and collective memory load (especially under pressure), drawing attention to the articulation of good questions, and arguably, fostering a broader analysis of the situation which takes into account the range of possible consequences of a course of action.

5. Acknowledgements

Our thanks to the Co-OPR PI Austin Tate (Univ. Edinburgh) for initiating this work. Co-OPR was sponsored by the Defence Advanced Research Projects Agency (DARPA)'s Advanced Technology Office in joint work with the United States Joint Forces Command (USJFCOM). The I-X project is sponsored by the Defense Advanced Research Projects Agency (DARPA) under agreement number F30602-03-2-0014.

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Modelling the Iraq Debate: Mapping Argumentation in a Document Corpus

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Abstract

This case study illustrates our use of Compendium to support a form of conventional concept mapping, plus post-hoc Dialogue Mapping as a way to tease out and integrate, at various granularities, the Issues, Positions and Arguments raised in a set of published articles on the Iraq war. We also explain the use of Nestor Web Cartographer, another concept mapping tool with specific document analysis and annotation capabilities.

1. Introduction: argument mapping tools for text analysis

This analysis was conducted as part of the [GlobalArgument.net](#) experiment which we initiated in early 2005 as a forum for systematically comparing computer-supported argumentation tools. However, the basic methodology and representational conventions we describe could be adopted for analysing any corpus of documents, with respect to the contributions they make. GlobalArgument.net Experiment 1: *The Iraq Debate* published links to a corpus of 25 articles by leading commentators with different backgrounds, who with varying degrees of vehemence, were either in favour of, relatively neutral on, or opposed to, the invasion of Iraq and the toppling of Saddam Hussein.

The hypothesis was that hypermedia concept/argument mapping tools should help as an analyst's tool for making sense of a corpus of texts:

- **for a given article:** mapping tools should help to clarify (at some level of granularity, dependent on the analyst) the contributions it claims to make and its argumentative structure
- **for the 'gestalt' of the whole corpus:** mapping tools should help to clarify the cross-connections and emerging themes which one would expect someone with a grasp of the debate (as expressed in the articles) to have, and communicate clearly.

We introduce two tools in this paper. [Compendium](#) has methodological and technological aspects. The software is a hypermedia concept mapping tool, details of which are presented by [Selvin \(1999\)](#), and also on the [Compendium Institute website](#). The methodological aspects are Conklin's Dialogue Mapping (Conklin, 1980) for the capture of physical or virtual discussions, in real-time or post hoc (capturing and structuring Issues, Positions and Arguments), and a model-driven variant developed by Sierhuis and Selvin, called Conversational Modelling ([Selvin, 1999](#)), for the collective analysis of a problem which exploits the software tool's 'T3' features: Templates, Transclusions and Tags. Both extend Rittel and Kunz's (1970) IBIS notation and 'argumentative design' approach to complex societal dilemmas, which they dubbed 'wicked problems'.

[Nestor Web Cartographer](#) was developed in France by Romain Zeiliger in 1996. Its main purpose is to map web information. It is a graphic web browser: an editor of html pages and a cartographer with synchronous and asynchronous resources to support collaborative learning.

This software dynamically builds a flexible and navigable overview map of the hyperspace when users interact with it. Nestor automatically registers all the URLs accessed in a map, showing the process of navigation. The map can be re-arranged and new objects can be created: documents, links, annotations, sub-maps, tours, search keywords and conceptual areas.

2. Scope of the Experiment “Iraq Debate” analysis

The initial reference for the analysis of Iraq debate was the very helpful paper “*One war, many theories*” by Michael Cohen (2005) as part of GlobalArgument.net Experiment 1: *The Iraq Debate*. He reviews the fundamental positions of pro-war and anti-war commentators, and distills from these some themes and questions which provided part of the structure for our top level Compendium map. We used this review paper as our macrostructure since we are not experts in this field, but were able to follow his analysis, and could investigate what Compendium could contribute to understanding and navigating the corpus when viewed through Cohen’s analytic lens.

Cohen asks “How can we do justice to the multiplicity of positions on the war?”, and proposes three concepts to organise the body of arguments:

- **Power**, defined as the capacity to produced intended effects
- **Degree of institutionalisation**, or the degree to which certain values and procedures stemming from them are embodied in a regulatory environment (impacting the role of organizations such as the UN)
- **Legitimacy**, the moral virtues of a certain act or value such that it finds affinities across a broadly defined populace or societal grouping

Cohen writes:

“In short, the majority of the literature on the American invasion of Iraq in April 2003 appeals to one of the three facets of the invasion mentioned above. Of course all the theories imply a position toward all three of these facets, however in most cases it is the direct appeal to one that both gives the theory its structure and most clearly grants it its explanatory prowess, generating its position on the American invasion in the affirmative or negative. And finally, it will be seen that those commentators advocating a position that appeal to factors such as the person of Saddam Hussein, Iraqi stockpiles of WMD’s and chemical weapons and connections to terrorist groups, sanctions and weapons inspection procedures, or other qualifications or conditions, can be neatly fitted in the schema outlined above.”

We focused on two sub-Issues as a mini-template around which to organize the ideas:

- What were the causes of the Iraq war?
- What were the consequences of this war?

Our orientation in this exercise was to map the contributions of the selected articles, with relatively little effort devoted to adding in our own analyses – most nodes are transcluded back to quotes from the source articles, and we use Cohen’s three principles to organize the overview maps to convey the gestalt. However, mapping is not an objective process. The quality of maps (or any model, of course) is unquestionably a function of the mapper’s grasp of the subject matter and of the modeling tool. In this case, the analyst (Okada) was herself learning to use Compendium, and was not an Iraq expert but a student seeking to learn about the Iraq debate; another analyst would undoubtedly create different maps. Although we use Cohen’s principles, argument mapping’s contribution to grasping the *gestalt* of the debate rests on how we model

connections between individual maps of articles. We are making an interpretive move that goes beyond Cohen's analysis when we extract a quote, classify, transclude, tag or link a node, since this changes the shape of the digital space along one or more dimensions.

In summary, the point is to reflect on:

- **A product:** a hypertext using Compendium's representational palette (supported by Nestor Web Cartographer) to assist navigation via embedded maps, IBIS rhetorical structure, and tag-based transclusions
- **A process:** of authoring and navigating such an artifact, specifically:
 - **Analytical process support:** how Compendium assists the analyst's modeling task
 - **Reading process support:** how Compendium assists the reader's task of comprehending the analyst's work

3. Argument mapping methodology

The hypertext argument maps produced from this exercise are available at: www.kmi.open.ac.uk/projects/compendium/iraq/

Faced with a corpus of documents, we stepped through the following process:

- define a visual notation (which evolved through the analysis) and was summarized in the opening map to assist the reader:

The diagram illustrates a hypertext argument map. It features a central node labeled 'MAP ICON' and 'NODE ICON' with associated statistics: 'Number of nodes in this map: 12' and 'Number of hyperlinks to others maps where this map is transcluded: 9'. A 'MENU BAR' is located at the bottom. A table on the right lists 'TAGS' for various categories:

	TAGS
(Sentence)	(question) (statistical data) (definition) (statement)
Causes	C1: Weapons C2: Terrorism C3: Security
Effects	E1: Violence E2: US Occupation E3: Reconstruction
Institutions	I1 : United Nations I2 : Disarmament
Norms	N1: Legitimacy N2: Preemption N3: Freedom
Power	P1: Power P2: Democracy P3: Oil

- define a top level node tagging scheme based on:
 - Cohen's framework (Power, Institutions, Norms)
 - Our Issue-template focused on Causes and Consequences of the war
 - read each article and select the main sentences based on the tag scheme

- identify the most frequent keywords in the text
- use these keywords to specialize the top level tags, e.g.
 - *Causes* is specialized into *C1: Weapons, C2: Terrorism, C3: Security*
 - *Norms* is specialized into *N1: Legitimacy, N2: Preemption, N3: Freedom*
- classify and categorise the sentences that we selected using the most significant keywords
- map each article using IBIS to highlight the key issues and responses, tagged accordingly, and giving a visualization of the argument structure
- integrate the claims made in the articles, using the tags to harvest related nodes across all maps, and then organise them by author and theme in new synthesis maps which convey dimensions to the debate's 'gestalt structure'

Let us illustrate these steps in more detail. First, experimenting with Nestor Web Cartographer, a map was developed to classify 25 documents and 26 keywords.

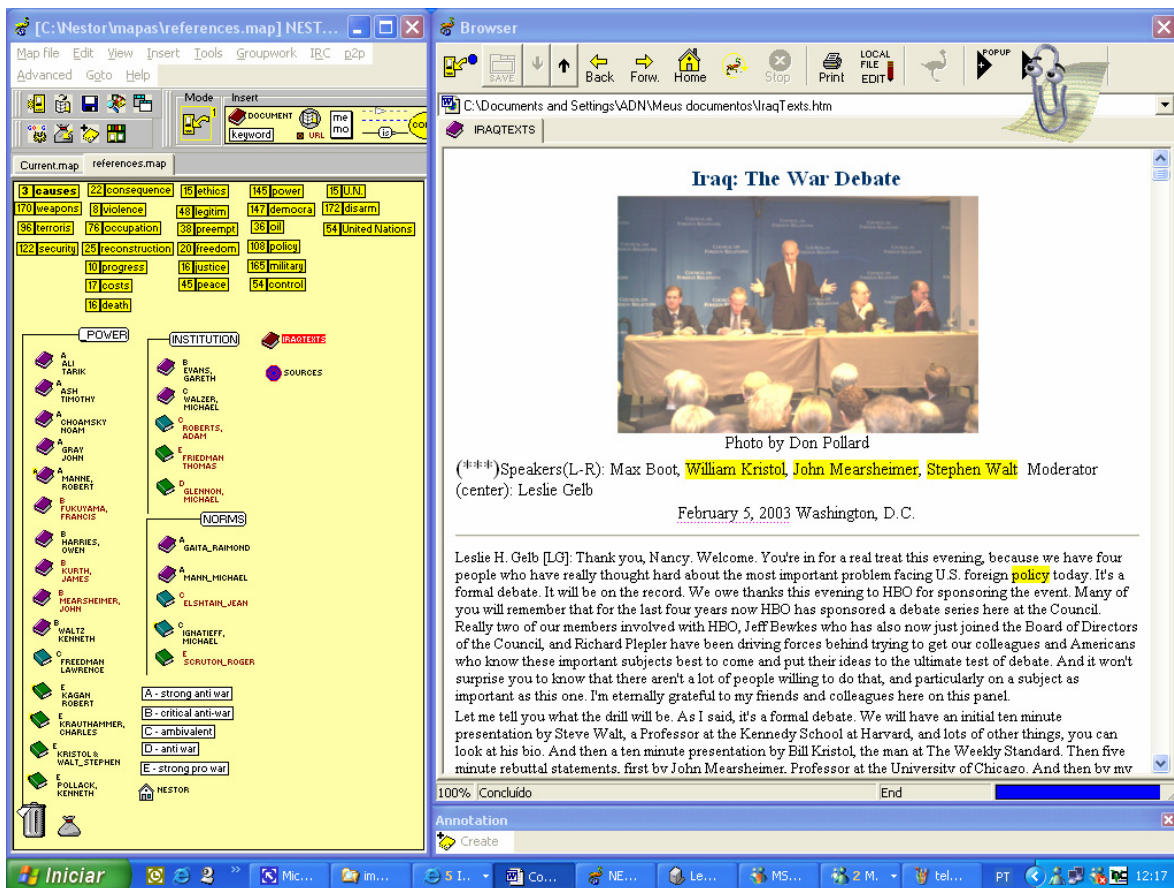


Figure 1 – Map of the Iraq Debate Sources created in Nestor Web Cartographer

The Nestor map helped us to:

- quickly navigate between many documents: all the URLs accessed in a hyperlink document are automatically registered in a web map and the content of each hyperlink mapped can be read beside the map.
- identify easily the main sentences and paragraphs using the keywords which had been defined

- locate all the questions asked in the text (through a simple search on “?”). Note, however, that these are not necessarily good organizing questions for integrating material across the corpus, since the particular questions asked are also shaped by each author’s rhetorical style and goals.
- highlight the relevant and meaningful information (pro and against the war)
- register comments about the information selected (question/ statistical data/ fact/ hypothesis/ pro/ con/...)
- get an approximate overview based on the frequency of each keyword in each text, and also across all texts.
- define the main categories to start the qualitative analysis of the content

Next, using Compendium, a map for each document was constructed, resulting in 25 article maps.

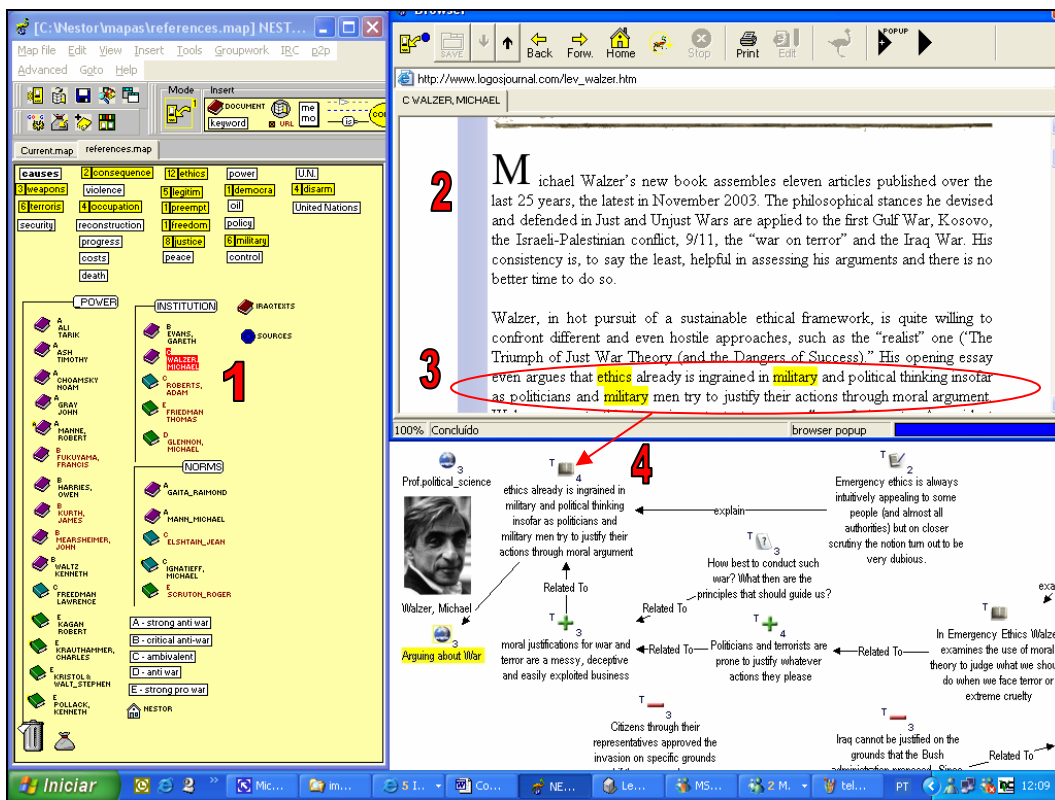


Figure 2 – Moving from text analysis in Nestor Web Cartographer (left and top windows) to construct the argument map in Compendium (lower window)

During this process, we used both pieces of software at the same time. We copied the selected information from Nestor map to Compendium Map, classifying each node using the tag scheme:

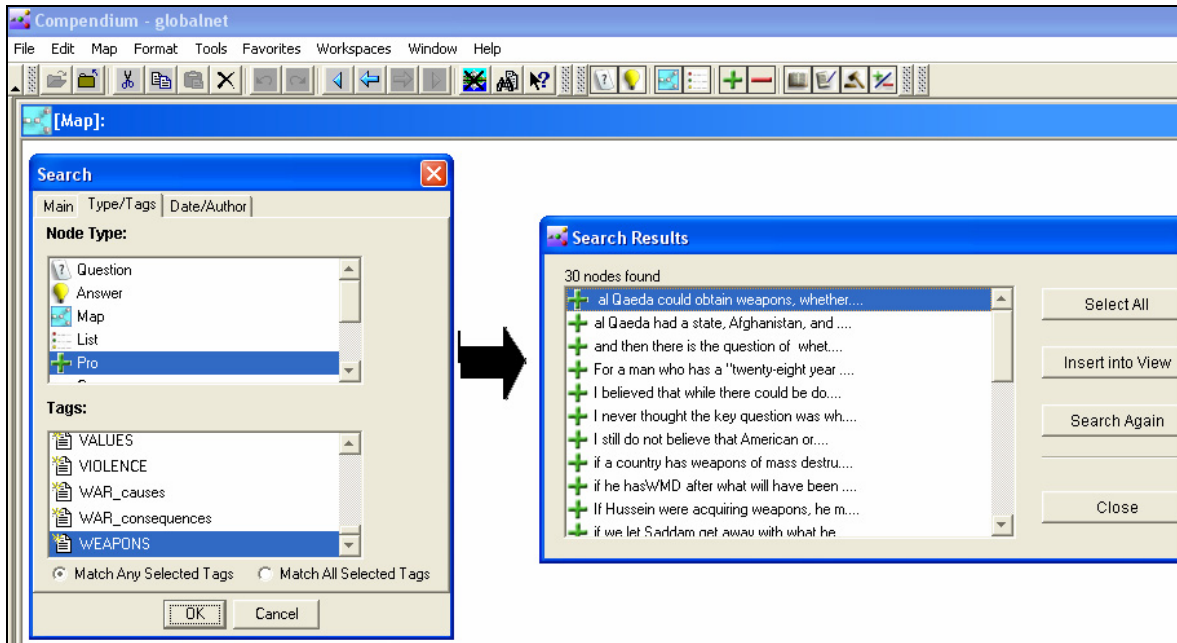
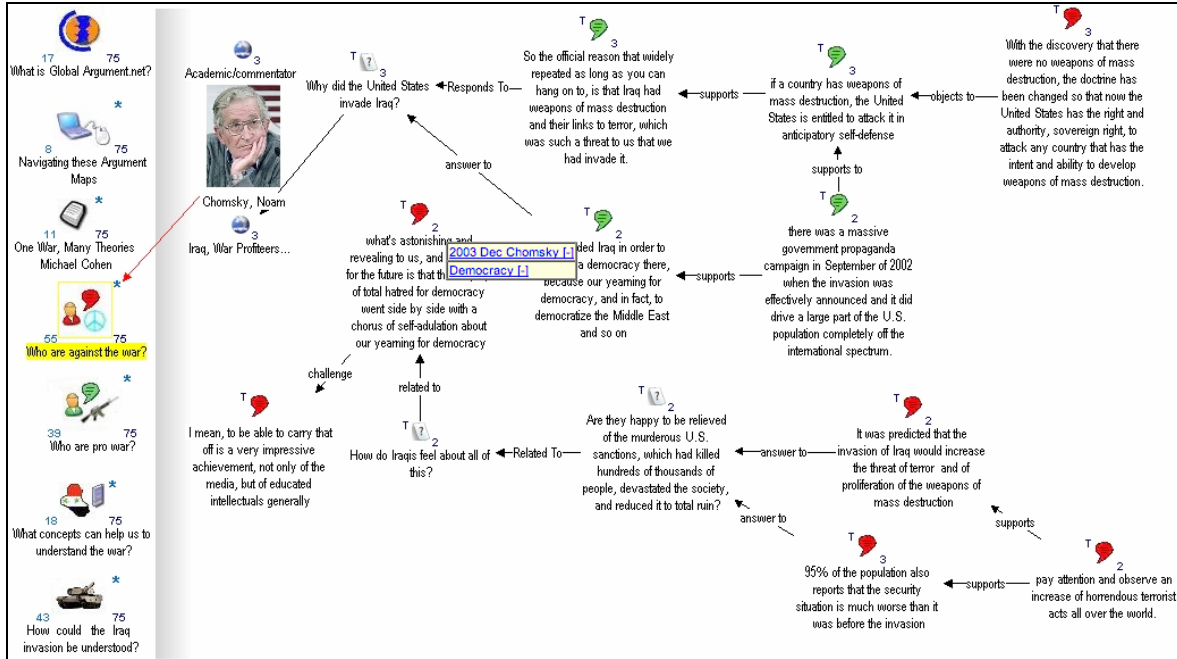


Figure 3 – Harvesting all nodes in Compendium through a search on specific node type(s) + tag(s)

- identify on mouse rollover, the category of this information through the “tags”, the final tag scheme being:

	TAGS
(Sentence)	(question)
	(statistical data)
	(definition)
	(statement)
Causes	C1: Weapons
	C2: Terrorism
	C3: Security
Effects	E1: Violence
	E2: US Occupation
	E3: Reconstruction
Institutions	I1 : United Nations
	I2 : Disarmament
Norms	N1: Legitimacy
	N2: Preemption
	N3: Freedom
Power	P1: Power
	P2: Democracy
	P3: Oil

represent visually the argumentation structure of each document. For instance, the article map for Chomsky was:



The article maps provide certain visual and interactional affordances:

- identify at a glance, the role of an information element by the node icon:
 - (?) question
 - (+) pro war statement
 - (-) anti war statement
 - (*) concepts or definitions
 - (#) statistical data

Finally, gestalt maps are constructed to provide perspectives across the “responses” of authors to the two key issues we wanted to focus on (causes and effects of the war), and around Cohen’s organising themes.

Firstly, we group maps around writers classified by Cohen as for and against the war, e.g.

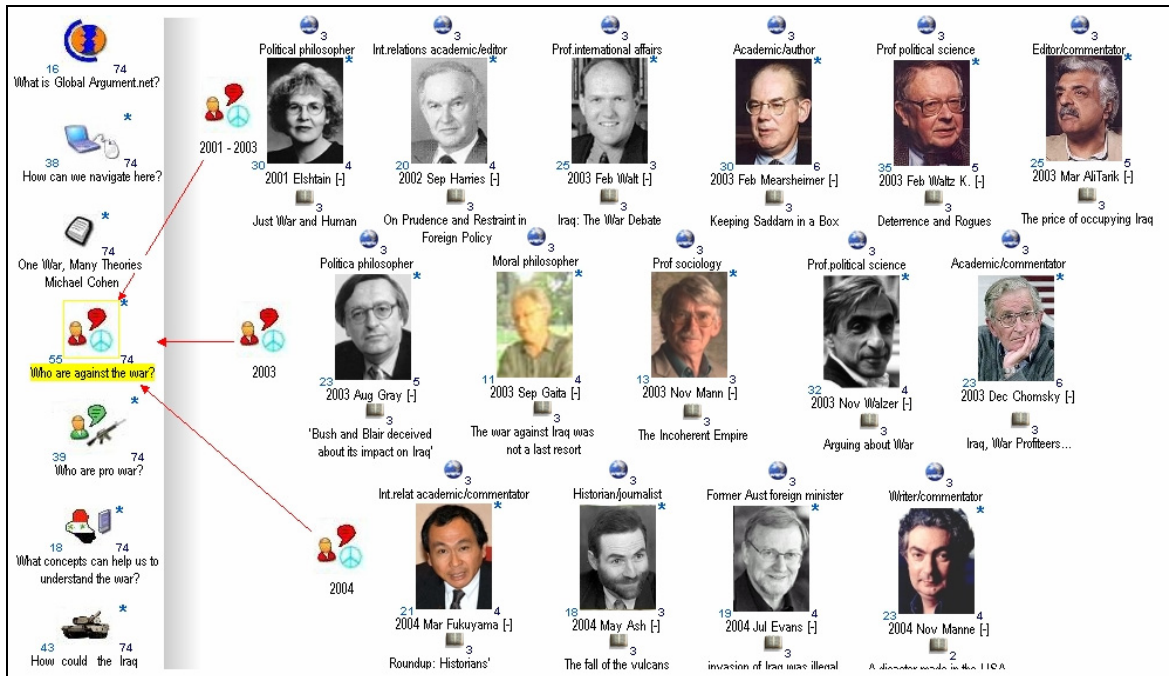


Figure 4 – The top level navigation map for “Who are against the war?”

Secondly, we organize maps around Cohen’s question *What concepts can help us understand the war?*

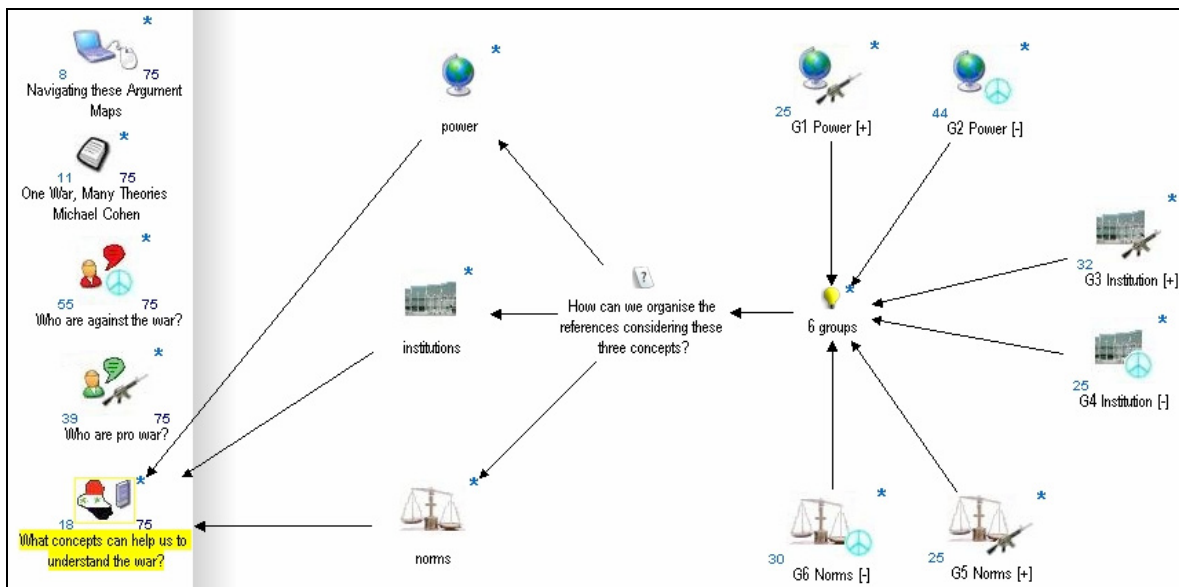


Figure 5: Top level map linking to pro-war and anti-war maps around Cohen’s three themes of Power, Institutions and Norms. Clicking on the *Pro-war Institutions* map opens the following view.

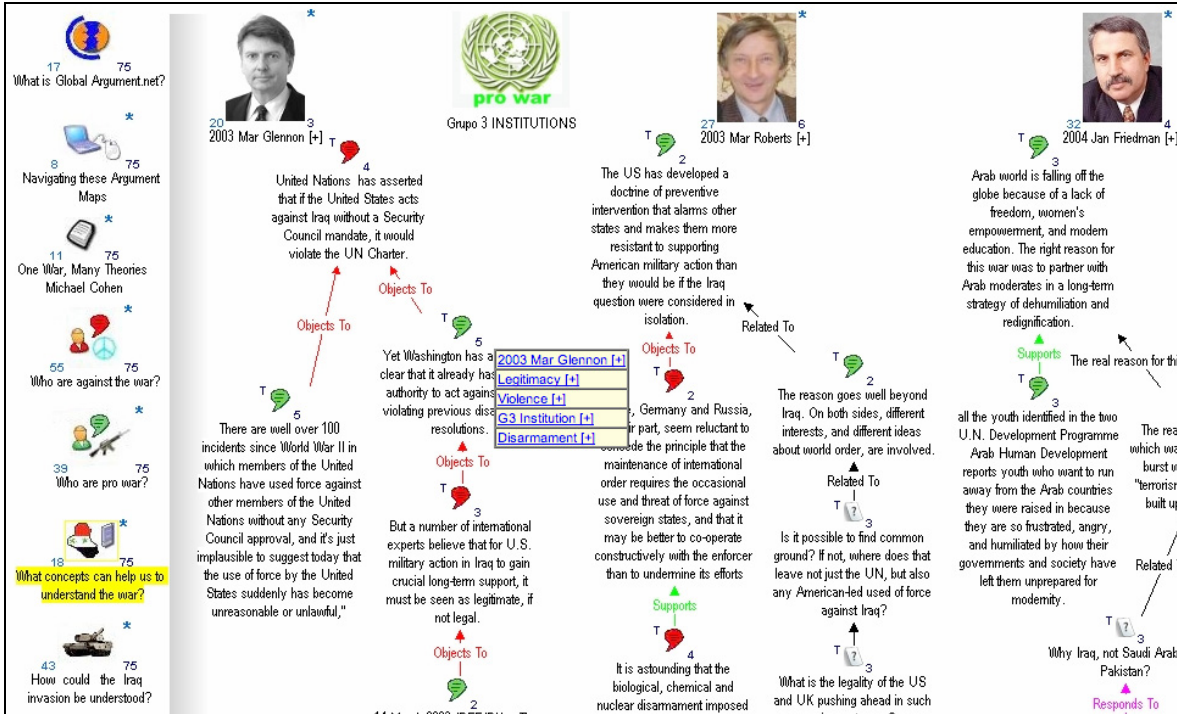


Figure 6: Gathering all the *Pro-war Institutions* nodes, i.e. contributions which refer to a pro-war position which discuss primarily the role of the UN

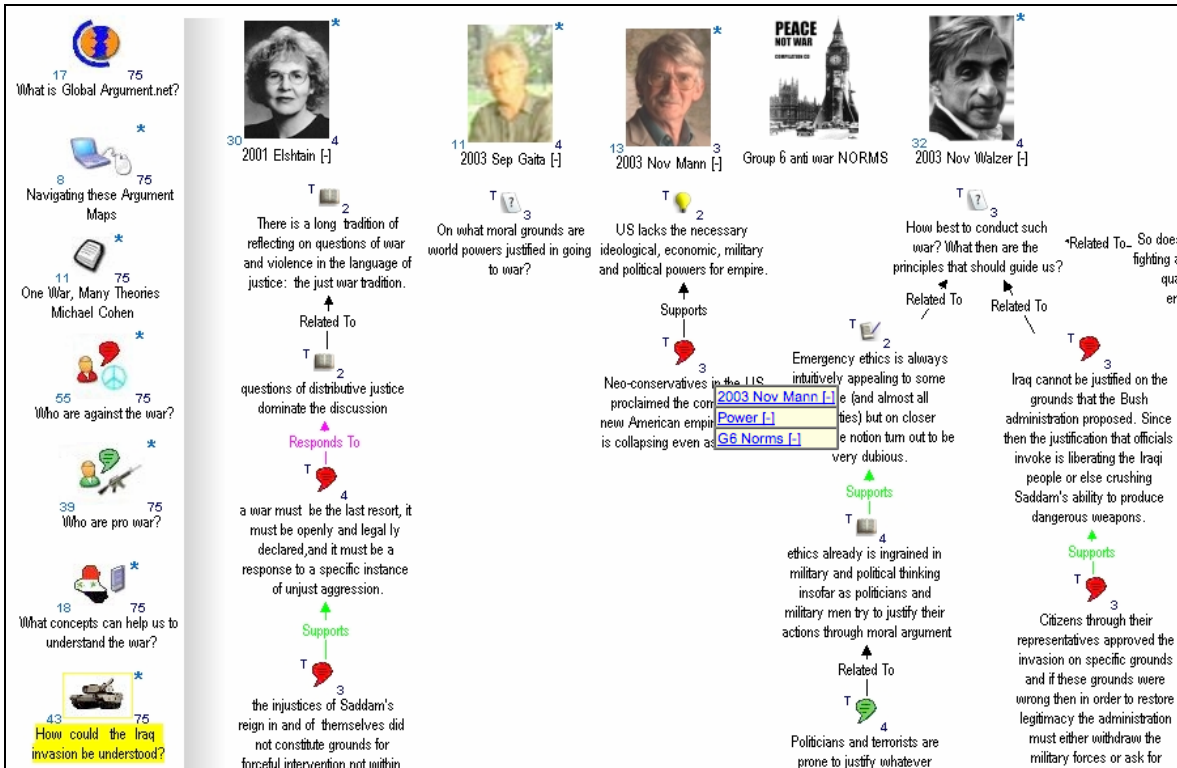


Figure 7: Contributions with the *Antiwar* and *Norms* tags, opened from Figure 5.

Finally, we organise maps around the general question *How could the Iraq invasion be understood?*, in which we use raise the questions of the war's causes and effects, and Cohen's

Norms (ethics), Institutions and Power configurations, and map pro- and anti-war responses classified by the keyword enriched tag scheme (e.g. *What are the war's effects?* is answered by pro- and antiwar contributions on *Violence; Occupation; Reconstruction*).

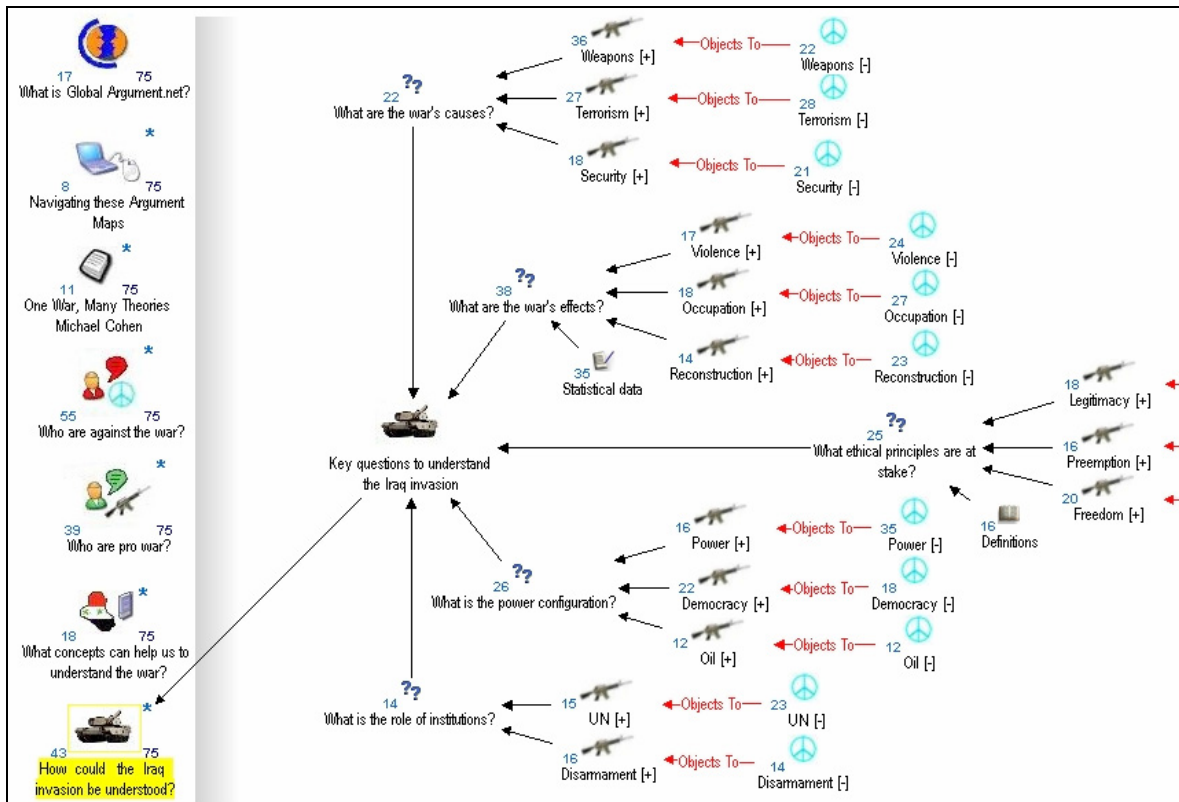


Figure 8: The top level map with links to submaps organised around key issues.

Zooming in on the issue: *What ethical principles are at stake?* shows pro- and anti-war responses along the three themes of *Legitimacy, Preemption and Freedom*:

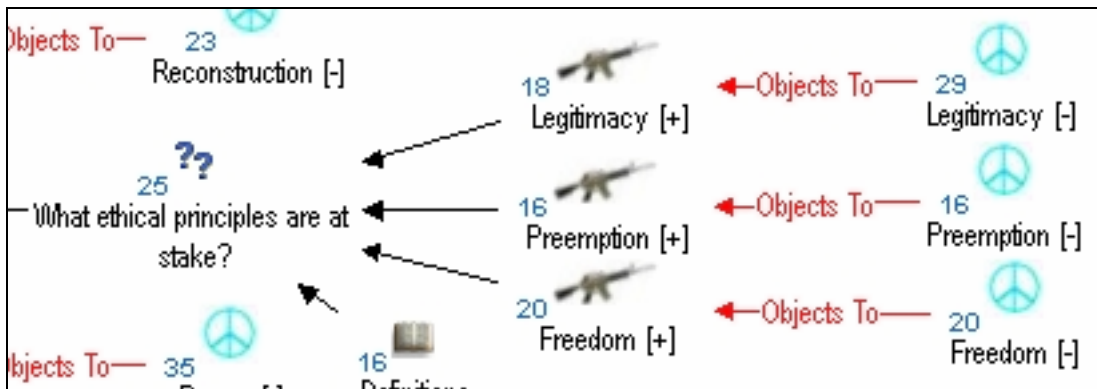


Figure 9: Zooming in on the issue: *What ethical principles are at stake?*

The issue *What ethical principles are at stake?* is in fact a map, which when opened shows the different interpretations of this question by different writers:

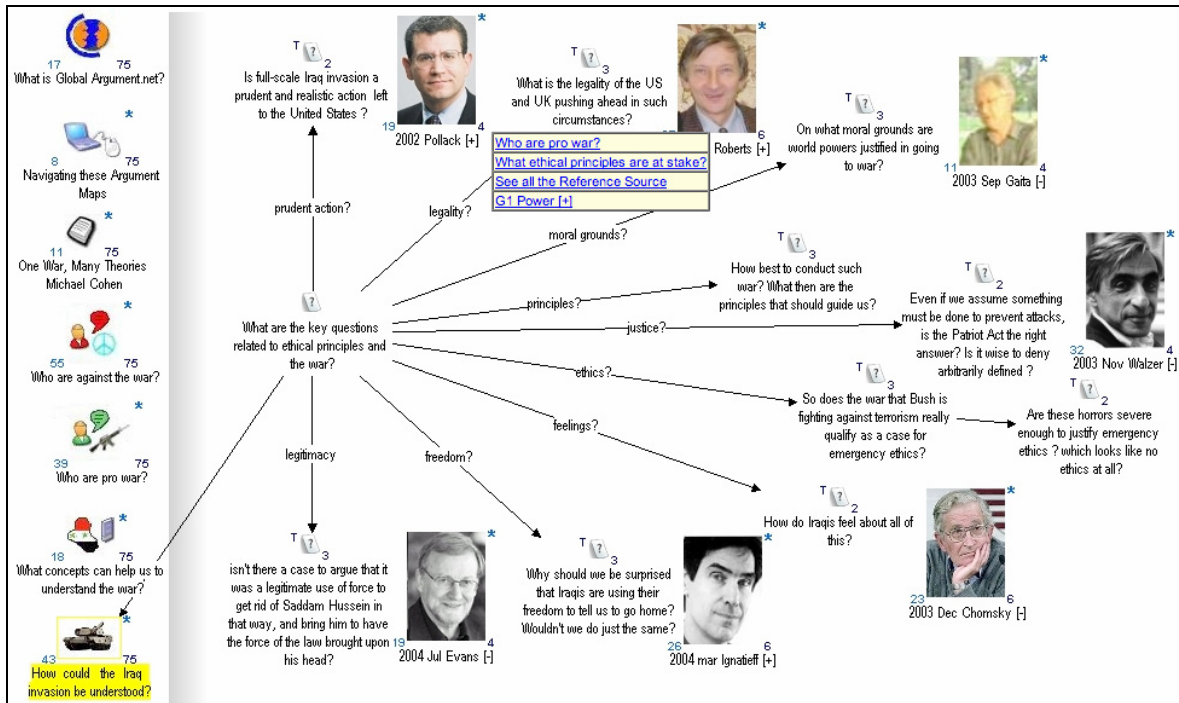


Figure 10: Inside the issue map: *What ethical principles are at stake?*

We can then inspect the pro- and anti-war responses to *What ethical principles are at stake?* on the theme of, for instance, *Preemption*:

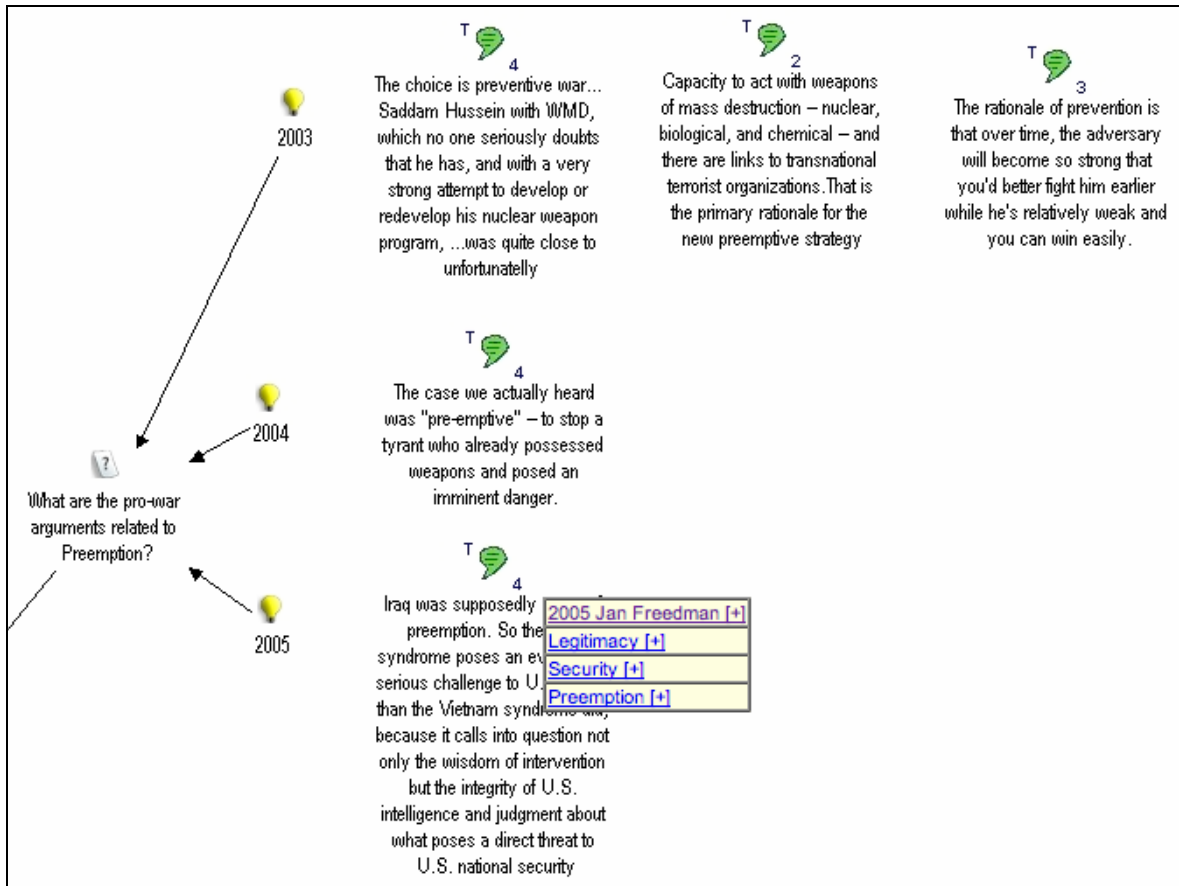


Figure 11: What are the pro-war arguments related to Preemption? Responses are grouped by date.

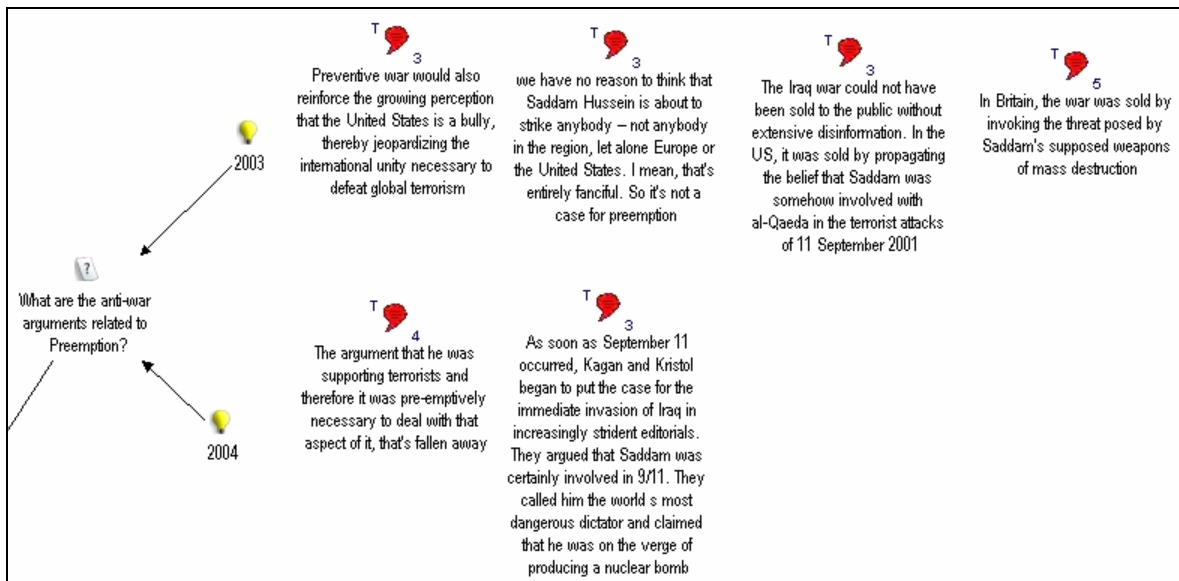


Figure 12: What are the anti-war arguments related to Preemption?

4. Future work

Two strands of work suggest themselves as priorities. Firstly, our Iraq Debate hypertext has not yet been empirically evaluated with independent readers, which is a research that we wish to conduct. We would also like to validate our modeling of Cohen's analysis with him.

Secondly, the GlobalArgument.net experiment was set up to facilitate comparison of the strengths and weaknesses of different approaches, but this process is still at an early stage. A comprehensive suite of computer-supported argument analysis tools would assist in identifying gaps, weaknesses and flaws of different sorts in a debate: questions without answers, statements not substantiated, flawed reasoning, and so forth.

This is an issue partly of representational granularity: other approaches model different kinds of argumentation more formally (e.g. see the work reported in the workshop series on *Computational Modelling of Natural Argument*, eg. CMNA 2005¹⁴). Such approaches tease apart the fine-grained structure of what in Compendium might be expressed as a position, pro/con, or supports/challenges link, without further differentiation. Complementary approaches would clarify, for instance, exactly what form of argument is being used to link a pro to a position?

However, this is also an issue of the nature of the debate, the user's skill, and the nature of the tool. Concept mapping tools have the advantage of not requiring a lot of formalisation before they start to 'pay back'. They are designed to scaffold cognition by providing a mirror for structured reflection. There is no requirement for the whole argument to be modeled so formally that a knowledge-based engine can then reason over the structure. Ambiguities, differences in granularity, variations in weighting, and simply missing information can be tolerated by the software because it is not trying to interpret the structure and give 'answers' (such as 'what is the strongest position?' or 'show me flawed reasoning'). Such an approach is, arguably, appropriate when confronted by 'wicked problems' (as characterized by Rittel) which are defined as problems which resist a lot of formalisation. However, there remains scope for investigating how Compendium could play a more active role in highlighting structural weaknesses in argument maps of this sort, particularly if templates (with predictable structure) are used systematically as an analytical lens, or conversely, if 'patterns' can be defined and used to search a database for exact or approximate matches which the analyst has missed.

5. Conclusions

From our own experiences as authors we can summarise the benefits that we started to experience in the role of analyst and reader, and which ultimately we would want end users to gain. We welcome feedback on the extent to which we are achieving this objective:

- as already established in concept mapping research, from the analyst's perspective, the cognitive discipline of mapping the content and structure of documents and their interconnections promotes a greater level of engagement, than just reading conventionally
- for both analysts and other readers, an IBIS-based Compendium map communicates information that is not accessible at a glance in a prose document
 - number of, and relationships between, questions, concepts and definitions, statistical data, facts, statements and hypotheses
 - 'depth' in terms of the number of transclusions on a node (shown by the lower right digit on the icon)

¹⁴ <http://www.csc.liv.ac.uk/~floriana/CMNA5/>

- ‘weight’ in terms of the number of nodes in a map (shown by the lower left digit on the icon)
- classifications assigned to an idea (shown by the Tag rollover hint in the upper left of the icon)
- cross-connections and themes are made explicit in the gestalt integrative maps, identify, classify and integrate diverse sources and compare ideas from different authors writing at different times.

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Supporting Distributed Collaboration for Science Exploration

Maarten Sierhuis and Brent Reeves

RIACS/NASA Ames Research Center

A small Mars crew will undoubtedly collaborate with groups of scientists back on Earth. How this collaboration will happen is a matter of conjecture and experimentation. The Mobile Agents Architecture provides a means for implementing a computer supported Mars- and Earth-based science work system, which we first employed in 2004. This system includes both the human work practices and computer tools with dataflow management systems. Here human-centered design meets work process design. In the empirical design approach we are using in the Mobile Agents project we are guided by the capabilities of the people and their objectives. People are at the center of the total system, and people are supported in their work by computer tools. We start simple; asking basic questions such as how the Mars crew can communicate their daily EVA plans and captured science data during and after an EVA back to their colleagues in the Remote Science Team (RST) on Earth. This leads us to question what the role of an Earth-based science team should be. Can the RST participate in the planning of daily extra-vehicular activities on Mars? Will the RST be able to get the science data in time to make useful suggestions to the crew? Will the RST be able to follow the field crew's investigations? Will the crew be able to absorb the RST suggestions in a timely manner to develop a daily EVA plan? How will the RST EVA plan compare with the crew plan? For the field experiments in 2004 and 2005 we defined a relatively simple science work process integrating three pre-existing domain-general software tools, Brahms, ScienceOrganizer and Compendium. In this talk I will describe the Mobile Agents field tests, in particular focusing on the use of Compendium as a collaboration tool for a Mars Crew and a distributed RST on Earth.

Field Notes from a Dialogue Mapper

Jeff Conklin

Cognexus Institute

Over the past year I have engaged in three activities: using Compendium as a dialogue mapping practitioner, teaching dialogue mapping to other consultants, and finishing up a book about dialogue mapping. It turns out that these activities, falling at different points along the spectrum from practice to theory, have synergized in unexpected ways. This presentation reviews several tensions that have surfaced between the idealized theory of dialogue mapping and the practical realities of dialogue mapping complex conversations with multi-stakeholder groups. For example, what are the conditions under which a group is more naturally drawn to engaging with a shared display (versus simply talking to and looking at each other)? What does it take to get from maps to meeting minutes? What are the tricks that make IBIS a satisfactory notation even when the mapped questions aren't yet clear or compelling?

Expert Practice in Virtual Team Facilitation

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Abstract

I have been exploring virtual team facilitation with Compendium as a practitioner and researcher for most of the last decade. Recently, I've been closely analyzing video recordings of Compendium practitioners working with virtual teams, in an effort to discern how expert practitioners are able to respond rapidly and creatively to problematic situations, how the Compendium representation helps glue the teams together, and what aesthetic and ethical considerations appear to guide practitioner behavior.

1. Introduction

Definitions of "virtual team" on the web¹⁵:

A group of people that rely primarily or exclusively on electronic forms of communication to work together in accomplishing goals.¹⁶

A **Virtual Team** — also known as a [Geographically Dispersed Team](#) (GDT) — is a group of individuals who work across time, space, and organizational boundaries with links strengthened by webs of [communication technology](#). They have complementary skills and are committed to a common purpose, have interdependent performance goals, and share an approach to work for which they hold themselves mutually accountable.¹⁷

Virtual teams and virtual meetings proliferated throughout the 1980s and 1990s and quickly became a ubiquitous aspect of contemporary working life for many organizations. Compendium has been used in virtual team facilitation settings since the appearance of Microsoft NetMeeting in the mid-1990s. Even our early experiences with Compendium in these situations showed that, despite the drawbacks of balky data connections and the sometime difficulty of communicating with large teams over the phone, Compendium could provide a visual focus and means of integration that, at its best, appeared to work as well as or even better than face-to-face meetings, at least for certain tasks. After facilitating hundreds of such sessions, I became interested in better understanding what kind of facilitator (or "practitioner") actions and behaviors helped both achieve good outcomes for the teams involved, and also contributed to the effectiveness of the Compendium artifacts themselves -- the databases, reports, documents, and other materials generated and refined through the course of a project. In 2003, I began work on a doctorate at the Knowledge Media Institute, focusing on this area.

I have been working with participatory Compendium representations since the early 1990s, in a wide variety of industry and academic contexts. Doing such work, particularly when acting as the

¹⁵ <http://www.google.com/search?hl=en&lr=&oi=defmore&defl=en&q=define:Virtual+Team>

¹⁶ www.karinscourtyard.com/arkmanual/glossary.html

¹⁷ http://en.wikipedia.org/wiki/Virtual_team

facilitator for a collaborative effort, often under conditions of pressure and constraint, requires special skills and draws on particular capabilities.

My current research concerns expert human performance in helping people construct representations of difficult problems – a practice I refer to as participatory hypermedia construction (PHC), particularly in virtual team environments. I am interested in what happens when practitioners encounter sensemaking moments, when they must improvise in order to move forward, and in the aesthetics and ethics of their actions at such moments. Little is known about the practice of constructing hypermedia representations despite more than twenty years of existence of tools and surrounding research. What are the components of expertise in this domain? What are people who are able to work fluidly with the medium, especially in highly dynamic and pressured situations, actually able to do? In what ways does this expertise compare to that of analogous professions and practices?

This research draws connections between aesthetic aspects of the work of a PHC practitioner – particularly those concerned with improvisation and narrative – and ethical aspects, especially those concerned with participation and engagement. In what ways do these aspects of the work relate to and support each other? What can be gained from an understanding of the relationships of improvisation, narrative, participation, and engagement? Are there lessons to be learned from the intersection of these aspects in a specific (and still esoteric) practice that are generalizable to other practices, or to other issues in the literature about and consideration of the technologies involved in the practices?

The concept map in Figure 1 summarizes some of the key concepts I am investigating:

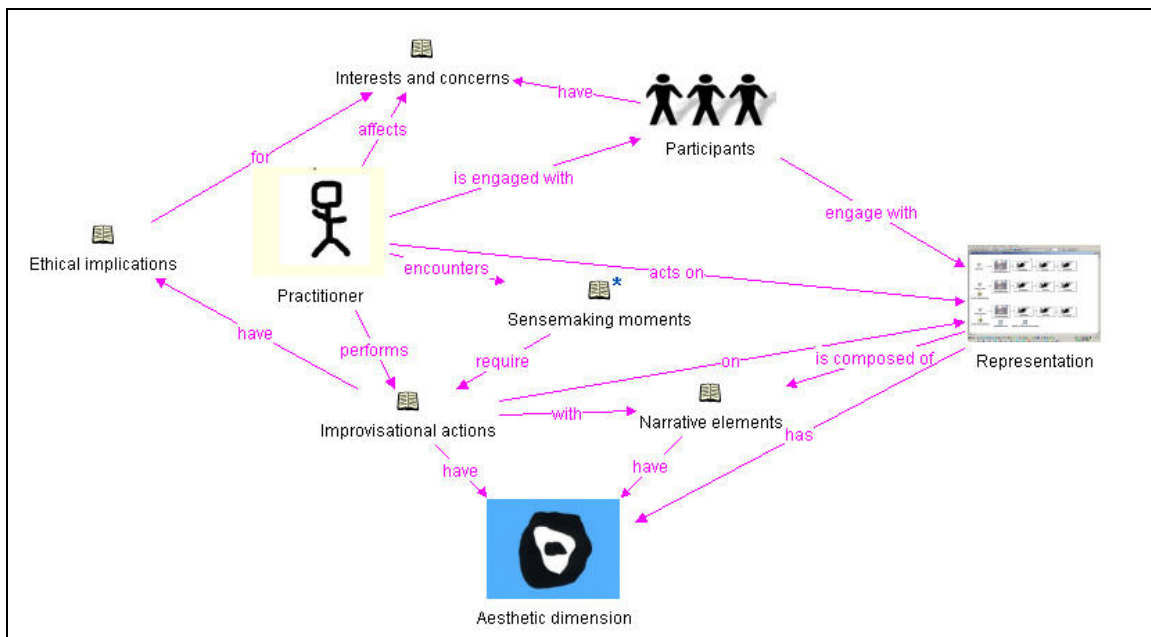


Figure 1: Key concepts

In Figure 1, a PHC practitioner is engaged with participants who are themselves engaged in some sort of collaborative or problem-solving activity. The practitioner acts on a hypermedia representation, which is itself composed of narrative elements – ideas and relationships arranged in meaningful ways over time. The participants, who bring to the event their interests and concerns (along with their relationships to one another, their communicative capacities, their constraints, and other contextual factors) also engage with the representation, if and when they are drawn to it. In the course of the practitioner’s work, they encounter sensemaking moments

when forward progress is disrupted by some unexpected or problematic event. This requires the practitioner to perform improvisational actions with the narrative elements of the representation. These actions, like the representation itself, have an aesthetic dimension – that is, they are made with intention and meaningful form. Because the practitioner's actions affect the participants' interests and concerns, the actions have ethical implications. These considerations appear to form a useful framework for understanding facilitative actions building a Compendium representation in a virtual team context .

So far I have conducted two large-scale analyses:

- a grounded theory analysis of an episode of PHC practice
- a critical incident analysis of segments of the same episode of PHC practice

In April 2004 I had the opportunity to participate in the 2004 NASA Mobile Agents Field Trial, which resulted in a very large dataset of audio and screen capture recordings of field PHC practice. The grounded theory analysis of a portion of this data occupied many months, both because the dataset was so rich and simply constructing a detailed audio and screen-capture transcript took far longer than I imagined, and also because the kinds of concepts and categories that began to emerge kept me returning to the data for subsequent passes so as to analyze from fresh perspectives.

At the conclusion of that work, I felt that although it had been richly generative, the grounded theory analysis did not get to the depth of insight that I was interested in about how and why practitioners make individual hypermedia "moves" and how such moves could be characterized in terms of my principal interests (aesthetics, narrative, improvisation, sensemaking, and ethics). To address this, I took a critical incident analysis approach, looking in much more depth at a few key segments of the session I had done the grounded theory analysis of. In the course of this work, further clarity and refinement of my categories and framework emerged.

2. Discussion

Capturing and characterizing skilled practitioner actions along aesthetic and ethical lines is not a matter of depicting the seamlessness, perfection, or mastery of those actions, although the actions do at times rise to that level. Even using the terms "artistry" and "expertise" seem to imply a closed state, a sense of effortlessness or exaltedness, whereas, as is quite clear in this document, practitioner actions in real-time participatory hypermedia sessions are full of trade-offs, struggles, imperfections, and incompleteness, even at the highly elevated level of skill and sensitivity that Simon demonstrates. Characterizing practice, in my estimation, should not be about saying how perfect or seamless it is, but rather about simply describing *what* it is, what decisions are being made, what consequences those decisions have.

3. Future work

I am now engaged in the remainder of the research leading up to my doctoral dissertation. I am hoping this research will produce the following contributions:

- **A language for characterizing expert practice in participatory hypermedia construction, including a taxonomy of concepts.** As begun in the work described in the Practical Report chapter, I will provide an explanatory framework that can be used for similar analyses of PHC and analogous practices.
- **Validate the language and taxonomy against deep observation of in situ practice.** As described further below, my research will include validation of the explanatory framework with my research subjects.

- **Extend the work of researchers looking at analogous practices.** Researchers such as Aakhus, Sawyer, Yoong, Seddon and others have taken similar approaches to those I propose. In their work analyzing analogous practices, such as dispute mediation, GSS facilitation, teaching, and improvisational music and theater, they have employed various qualitative methods and (separately) touched on the central aspects of my conceptual framework. My research will extend their work not only by applying their approaches to a new practice (PHC), but by a unique combination of research methods and key conceptual elements (aesthetics, ethics, improvisation, narrative, and sensemaking) in the observation of expert practice.